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STAR is categorized by 10 major subject divisions divided into 76 specific subject categories and one general category/division. The major subject divisions are listed in the Table of Contents, together with a note for each that defines its scope and provides any cross-references. For example:

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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Abstracts in *STAR* are grouped by specific category, the categories appearing in sequential order. Category breaks in the abstract section are identified by the category number and title, and a scope note. Cross-references to other categories are provided as appropriate. For example:

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

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For related information see also *Astronautics.*

01 AERONAUTICS (GENERAL) 1861

02 AERODYNAMICS 1861

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 1865

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 1865

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications and Radar.*

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 1866

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 1867

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 1867

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 1868

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 1869

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) 1871

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

13 ASTRODYNAMICS 1871

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 1872

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

15 LAUNCH VEHICLES AND SPACE VEHICLES 1872

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

16 SPACE TRANSPORTATION N.A.

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING 1873

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 1873

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION 1882

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 1882

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) N.A.

24 COMPOSITE MATERIALS 1883

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials.*

25 INORGANIC AND PHYSICAL CHEMISTRY 1887

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 1889

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 1892

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 1894

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 1895

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 1895

includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 1904

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

33 ELECTRONICS AND ELECTRICAL ENGINEERING 1907

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

34 FLUID MECHANICS AND HEAT TRANSFER 1909

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 INSTRUMENTATION AND PHOTOGRAPHY 1912

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation.*

36 LASERS AND MASERS 1913

Includes parametric amplifiers.

For related information see also *76 Solid-State Physics.*

37 MECHANICAL ENGINEERING 1917

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 1922

Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 1922

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

GEOSCIENCES

Includes geosciences (general); earth resources and remote sensing; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.

For related information see also *Space Sciences.*

42 GEOSCIENCES (GENERAL) **1935**

43 EARTH RESOURCES AND REMOTE SENSING **1939**

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

44 ENERGY PRODUCTION AND CONVERSION **1942**

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

45 ENVIRONMENT POLLUTION **1943**

Includes atmospheric, noise, thermal, and water pollution.

46 GEOPHYSICS **1944**

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

47 METEOROLOGY AND CLIMATOLOGY **1946**

Includes weather forecasting and modification.

48 OCEANOGRAPHY **1950**

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

51 LIFE SCIENCES (GENERAL) **1952**

52 AEROSPACE MEDICINE **1952**

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 BEHAVIORAL SCIENCES **1952**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT **1953**

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

55 SPACE BIOLOGY **N.A.**

Includes exobiology; planetary biology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) **1954**

60 COMPUTER OPERATIONS AND HARDWARE **1954**

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

61 COMPUTER PROGRAMMING AND SOFTWARE **1956**

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 COMPUTER SYSTEMS **1960**

Includes computer networks and special application computer systems.

63 CYBERNETICS **1961**

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

64 NUMERICAL ANALYSIS **1962**

Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY **1965**

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS **1967**

Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS **1967**

Includes topology and number theory.

PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

For related information see also *Engineering.*

70 PHYSICS (GENERAL) **1968**

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

71 ACOUSTICS 1979
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution.*

72 ATOMIC AND MOLECULAR PHYSICS 1980
Includes atomic structure, electron properties, and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 1982
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation.*

74 OPTICS 1982
Includes light phenomena and optical devices.
For lasers see *36 Lasers and Masers.*

75 PLASMA PHYSICS 1984
Includes magnetohydrodynamics and plasma fusion.
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76 SOLID-STATE PHYSICS 1985
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1990
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1991
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1991
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 1992
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1992
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1992
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 1993
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 1994
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 2011
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 2011
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 2012

Note: N.A. means that no abstracts were assigned to this category for this issue.

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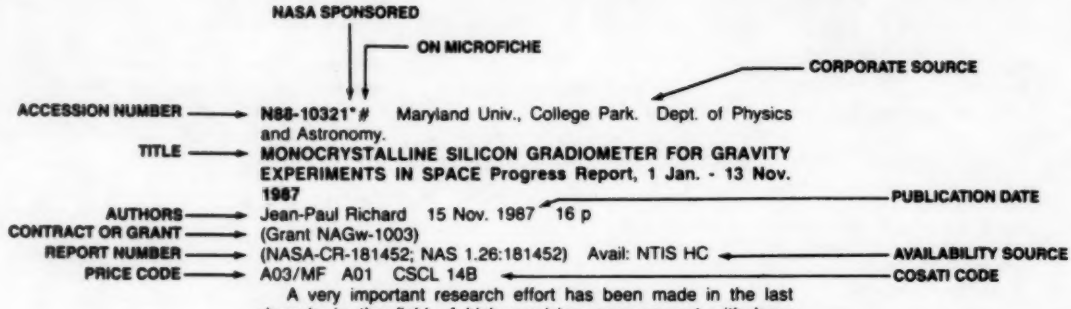
PERSONAL AUTHOR INDEX I-47
CORPORATE SOURCE INDEX I-55
CONTRACT NUMBER INDEX I-67
REPORT/ACCESSION NUMBER INDEX I-69

TYPICAL CITATION AND ABSTRACT



A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 14/ JULY 23, 1988

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N88-21116*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL ANALYSIS OF THREE-DIMENSIONAL VISCOUS INTERNAL FLOWS
Rodrick V. Chima and Jeffrey W. Yokota (Sverdrup Technology, Inc., Cleveland, Ohio.) 1988 10 p Proposed for presentation at the 1st National Fluid Dynamics Congress, Cincinnati, Ohio, 24-28 Jul. 1988; sponsored by AIAA, ASME, ASCE, SIAM and APS
(NASA-TM-100878; E-4112; NAS 1.15:100878) Avail: NTIS HC A02/MF A01 CSCL 01B

A 3-D Navier-Stokes code has been developed for analysis of turbomachinery blade rows and other internal flows. The Navier-Stokes equations are written in a Cartesian coordinate system rotating about the x-axis, and then mapped to a general body-fitted coordinate system. Streamwise viscous terms are neglected using the thin-layer assumption, and turbulence effects are modeled using the Baldwin-Lomax turbulence model. The equations are discretized using finite differences on stacked C-type grids and are solved using a multistage Runge-Kutta algorithm with a spatially-varying time step and implicit residual smoothing. Calculations have been made of a horseshoe vortex formed in front of a flat plate with a round leading edge standing in a turbulent endwall boundary layer. Comparisons are made with experimental data taken by Eckerle and Langston for a circular cylinder under similar conditions. Computer and measured results are compared in terms of endwall flow visualization pictures and total pressure loss contours and vector plots on the symmetry plane. Calculated details of the primary vortex show excellent agreement with the experimental data. The calculations also show a small secondary vortex not seen experimentally. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-21117*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE NASA LANGLEY LAMINAR-FLOW-CONTROL (LFC) EXPERIMENT ON A SWEPT, SUPERCRITICAL AIRFOIL: DESIGN OVERVIEW
Charles D. Harris, William D. Harvey, and Cuyler W. Brooks, Jr. May 1988 128 p
(NASA-TP-2809; L-16324; NAS 1.60:2809) Avail: NTIS HC A07/MF A01 CSCL 01A

A large-chord, swept, supercritical, laminar-flow-control (LFC) airfoil was designed and constructed and is currently undergoing tests in the Langley 8 ft Transonic Pressure Tunnel. The experiment was directed toward evaluating the compatibility of LFC and supercritical airfoils, validating prediction techniques, and generating a data base for future transport airfoil design as part of NASA's ongoing research program to significantly reduce drag and increase aircraft efficiency. Unique features of the airfoil included a high design Mach number with shock free flow and boundary layer control by suction. Special requirements for the experiment included modifications to the wind tunnel to achieve the necessary flow quality and contouring of the test section walls to simulate free air flow about a swept model at transonic speeds. Design of the airfoil with a slotted suction surface, the suction system, and modifications to the tunnel to meet test requirements are discussed. Author

N88-21118*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC PERFORMANCE OF NONAXISYMMETRIC NOZZLES WITH YAW THRUST-VECTORING VANES
Mary L. Mason and Bobby L. Berrier May 1988 79 p
(NASA-TP-2813; L-16389; NAS 1.60:2813) Avail: NTIS HC A05/MF A01 CSCL 01A

A static test was conducted in the static test facility of the Langley 16 ft Transonic Tunnel to evaluate the effects of post exit vane vectoring on nonaxisymmetric nozzles. Three baseline nozzles were tested: an unvectored two dimensional convergent nozzle, an unvectored two dimensional convergent-divergent nozzle, and a pitch vectored two dimensional convergent-divergent nozzle. Each nozzle geometry was tested with 3 exit aspect ratios (exit width divided by exit height) of 1.5, 2.5 and 4.0. Two post exit yaw vanes were externally mounted on the nozzle sidewalls at the nozzle exit to generate yaw thrust vectoring. Vane deflection angle (0, -20 and -30 deg), vane planform and vane curvature were varied during the test. Results indicate that the post exit vane concept produced resultant yaw vector angles which were always smaller than the geometric yaw vector angle. Losses in resultant thrust ratio increased with the magnitude of resultant yaw vector angle. The widest post exit vane produced the largest degree of flow turning, but vane curvature had little effect on thrust vectoring. Pitch vectoring was independent of yaw vectoring, indicating that multiaxis thrust vectoring is feasible for the nozzle concepts tested. Author

N88-21119# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Transportfysica.
MEASUREMENTS ON A HELICOPTER ROTOR [METINGEN AAN EEN HELICOPTERROTOR]
P. Beekman Nov. 1985 104 p In DUTCH
(R-764-S; ETN-88-91309) Avail: NTIS HC A06/MF A01

A model setup and a measuring system were realized, with which the flow field about and through a helicopter rotor was measured, in order to check correction term in rotor aerodynamics formulas. The flow about and through a helicopter rotor, classical momentum theory, and an extension and improvement of this theory are discussed. The pressure and velocity in the far wake were reliably measured with a Pitot tube. The absolute velocity and flow direction right underneath the rotor were accurately determined with a hot-wire anemometer. The measuring setup proves to be suited to revise the momentum theory. It is shown that momentum theory formulas for rotor aerodynamics have only a limited validity. ESA

N88-21120# Institut Franco-Allemand de Recherches, St. Louis (France).
AERODYNAMIC POSSIBILITIES FOR THE REALIZATION OF TRAJECTORY CORRECTIONS [AERODYNAMISCHE MOEGLICHKEITEN FUER DIE REALISIERUNG VON FLUGBAHNKORREKTUREN]
K. W. Naumann 23 Dec. 1986 48 p In GERMAN Presented at the Carl Cranz Company's Training Conference on Aussenballistik Einschliesslich Flugbahnkorrektur, Weil am Rhein, Federal Republic of Germany, 12 Dec. 1986
(ISL-CO-251/86; ETN-88-91637) Avail: NTIS HC A03/MF A01

Alternatives for the aerodynamic correction of flight trajectories are presented. The control by a lateral jet is especially promising if the projectile form is suited. The jet-inflow interaction as well as the projectile angle of attack can be used for energy-saving control. Control efficiency and drag reduction have to be treated with priority, especially for medium and long-range projectiles and for low-flying missiles. Three-axis-controlled, nonspinning projectiles are preferred for drag reduction; for spinning missiles momentum control is more suited than jet control. A combination between thrust vector control and angle of attack control is suited if the control requirements are low compared to the propulsion requirements. The fuel requirements of a jet control are not in opposition to a good control efficiency. ESA

N88-21121# Bristol Univ. (England). Dept. of Aerospace Engineering.
VORTEX FLOW OVER A DELTA WING WITH APEX FLAPS USING LASER FLOW VISUALISATION B.E. Thesis
D. M. Earnshaw and P. A. Holtom Jun. 1987 55 p
(BU-356; ETN-88-91896) Avail: NTIS HC A04/MF A01

The flow produced by apex flaps on a 70 deg swept delta wing was studied, using specially developed titanium tetrachloride smoke and laser light sheet flow visualization. The results for the flat plate delta are consistent with the work of other authors. The apex flap deflection has a significant effect on the flow, and may have applications in lift/pitch or roll control; it is, however, found to be a nonlinear device. A double vortex burst phenomenon is encountered at various configurations, while the addition of a fuselage to the model considerably modifies the flow. Detailed results on burst position as a function of apex flap angle, together with photographs indicating vortex structure are presented. ESA

N88-21122# Bristol Univ. (England). Dept. of Aerospace Engineering.
AN INVESTIGATION OF CRUCIFORM PARACHUTES AND TOWED TARGETS B.E. Thesis
B. V. Kemp and J. Pugh Jun. 1987 50 p
(BU-360; ETN-88-91900) Avail: NTIS HC A03/MF A01

Drag and stability characteristics of cruciform parachutes and means of reducing the drag on a towed target were studied. The test cruciform parachutes and banner materials were flown in different configurations in the 7 ft x 5 ft wind tunnel at speeds of 5 to 40 m/sec. The forces acting on the parachute and banners during flight were recorded, and visual observations of the flying characteristics noted. Maximum drag is provided by the zero porosity parachutes which are also the most unstable and have the highest spin rates. The most stable parachute, which also exhibits the lowest rate of spin is the high porosity parachute. For towed targets, netting material gives substantially less drag than solid material. Altering the shape of the banner has no great effect and the rectangular shaped banner has a lower C sub D than the pennant shaped banner. Slashes in the material detune ripples passing along the banner, thereby reducing drag. ESA

N88-21123# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Aerodynamics Dept.
[ACTIVITIES REPORT OF THE AERODYNAMICS DEPARTMENT] Annual Report, 1986
Sep. 1987 53 p Original contains color illustrations
(ETN-88-91979) Avail: NTIS HC A04/MF A01

Computation of nonviscous real gas flows at equilibrium with an upwind scheme; computation of turbulent flows by numerical solution of the Navier-Stokes equations; inverse solution of the 3D Euler equations; simulation of laminar-turbulent transition in natural convection; simulations of transitional channel-flow; application of the vortex particle method to a marine propeller and fairing; prediction of buffeting by a method of unsteady viscous-inviscid interaction; a boundary layer method for predicting viscous sheet separation in three-dimensional flow; homogeneous turbulence subjected to rotation effects; three-dimension separation in incompressible flow; flow of an incompressible fluid around a delta wing; boundary-layer computations applied to the study of three-dimensional flow; applications of hydrodynamic visualizations; definition of glider airfoils; design and test of a laminar horizontal tail; effect of the computation parameters on flows computed by 3D potential methods; separated flows on helicopter fuselage; wind tunnel tests of a helicopter blade tip; aerodynamics of hypersonic vehicles; determination of missile air intake characteristics; flow into the air intake of a fighter aircraft; computation of real gas glow through a hypersonic wind tunnel nozzle; and a method of analysis of surface temperatures in determining heat fluxes are discussed. ESA

N88-21124*# Lockheed Aeronautical Systems Co., Marietta, Ga.
APPLICATION OF HYBRID LAMINAR FLOW CONTROL TO GLOBAL RANGE MILITARY TRANSPORT AIRCRAFT
Roy H. Lange Apr. 1988 101 p
(Contract NAS1-18036)
(NASA-CR-181638; NAS 1.26:181638) Avail: NTIS HC A06/MF A01 CSCL 01A

A study was conducted to evaluate the application of hybrid laminar flow control (HLFC) to global range military transport aircraft. The global mission included the capability to transport 132,500 pounds of payload 6500 nautical miles, land and deliver the payload and without refueling return 6500 nautical miles to a friendly airbase. The preliminary design studies show significant performance benefits obtained for the HLFC aircraft as compared to counterpart turbulent flow aircraft. The study results at M=0.77 show that the largest benefits of HLFC are obtained with a high wing with engines on the wing configuration. As compared with the turbulent flow baseline aircraft, the high wing HLFC aircraft shows 17 percent reduction in fuel burned, 19.2 percent increase in lift-to-drag ratio, an insignificant increase in operating weight, and a 7.4 percent reduction in gross weight. Author

N88-21125*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
INVESTIGATION OF SUPERSONIC CHEMICALLY REACTING AND RADIATING CHANNEL FLOW Progress Report, 1 Jan. - 31 Dec. 1987
Mortaza Mani and Surendra N. Tiwari Jan. 1988 162 p
(Grant NAG1-423)
(NASA-CR-182726; NAS 1.26:182726) Avail: NTIS HC A08/MF A01 CSCL 01A

The 2-D time-dependent Navier-Stokes equations are used to investigate supersonic flows undergoing finite rate chemical reaction and radiation interaction for a hydrogen-air system. The explicit multistage finite volume technique of Jameson is used to advance the governing equations in time until convergence is achieved. The chemistry source term in the species equation is treated implicitly to alleviate the stiffness associated with fast reactions. The multidimensional radiative transfer equations for a nongray model are provided for a general configuration and then reduced for a planar geometry. Both pseudo-gray and nongray models are used to represent the absorption-emission characteristics of the participating species. The supersonic inviscid and viscous, nonreacting flows are solved by employing the finite volume technique of Jameson and the unsplit finite difference scheme of MacCormack. The specified problem considered is of the flow in a channel with a 10 deg compression-expansion ramp. The calculated results are compared with those of an upwind scheme. The problem of chemically reacting and radiating flows

are solved for the flow of premixed hydrogen-air through a channel with parallel boundaries, and a channel with a compression corner. Results obtained for specific conditions indicate that the radiative interaction can have a significant influence on the entire flow field. Author

N88-21126* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 225)
Apr. 1988 124 p
(NASA-SP-7037(225); NAS 1.21:7037(225)) Avail: NTIS HC A06 CSCL 01A

This bibliography lists 429 reports, articles, and other documents introduced into the NASA scientific and technical information system in March, 1988. Author

N88-21127*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
SURFACE FLOW VISUALIZATION OF SEPARATED FLOWS ON THE FOREBODY OF AN F-18 AIRCRAFT AND WIND-TUNNEL MODEL
David F. Fisher, David M. Richwine, and Daniel W. Banks May 1988 20 p Presented at the 4th Flight Test Conference, San Diego, Calif. 18-20 May 1988
(NASA-TM-100436; H-1481; NAS 1.15:100436; AIAA-88-2112)
Avail: NTIS HC A03/MF A01 CSCL 01A

A method of in-flight surface flow visualization similar to wind-tunnel-model oil flows is described for cases where photo-chase planes or onboard photography are not practical. This method, used on an F-18 aircraft in flight at high angles of attack, clearly showed surface flow streamlines in the fuselage forebody. Vortex separation and reattachment lines were identified with this method and documented using postflight photography. Surface flow angles measured at the 90 and 270 degrees meridians show excellent agreement with the wind tunnel data for a pointed tangent ogive with an aspect ratio of 3.5. The separation and reattachment line locations were qualitatively similar to the F-18 wind-tunnel-model oil flows but neither the laminar separation bubble nor the boundary-layer transition on the wind tunnel model were evident in the flight surface flows. The separation and reattachment line locations were in fair agreement with the wind tunnel data for the 3.5 ogive. The elliptical forebody shape of the F-18 caused the primary separation lines to move toward the leeward meridian. Little effect of angle of attack on the separation locations was noted for the range reported. Author

N88-21128*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
CONSTRUCTING GLOVED WINGS FOR AERODYNAMIC STUDIES
Marta R. Bohn-Meyer May 1988 20 p Presented at the 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100440; H-1487; NAS 1.15:100440; AIAA-88-2109)
Avail: NTIS HC A03/MF A01 CSCL 01A

Recently, two aircraft from the Dryden Flight Research Facility were used in the general study of natural laminar flow (NLF). The first, an F-14A aircraft on short-term loan from the Navy, was used to investigate transonic natural laminar flow. The second, an F-15A aircraft on long-term loan from the Air Force, was used to examine supersonic NLF. These tests were follow-on experiments to the NASA F-111 NLF experiment conducted in 1979. Both wings of the F-14A were gloved, in a two-phased experiment, with full-span(upper surface only) airfoil shapes constructed primarily of fiberglass, foam, and resin. A small section of the F-15A right wing was gloved in a similar manner. Each glove incorporated provisions for instrumentation to measure surface pressure distributions. The F-14A gloves also had provisions for instrumentation to measure boundary layer profiles, acoustic environments, and surface pitot pressures. Discussions of the techniques used to construct the gloves and to incorporate the required instrumentation are presented. Author

N88-21129# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
WALL INTERFERENCE ASSESSMENT AND CORRECTIONS FOR TRANSONIC ADAPTIVE WALL AIRFOIL DATA M.S. Thesis
Lawrence Lee Richard Green Apr. 1988 199 p
Avail: NTIS HC A09/MF A01

A nonlinear, 4-wall, post-test wall interference assessment/correction (WIAC) codes is developed. This code is applicable to transonic airfoil data from solid-wall wind tunnels with flexibly adaptable top and bottom walls. The WIAC code has been applied to several sets of NACA 0012 airfoil data, including many fully adapted test points. The data represent a broad range of model/tunnel configurations and possible wall-interference effects. Small corrections to the measured Mach numbers and angles of attack are obtained from the WIAC code even for fully adapted data; these corrections generally improve the correlation among the various sets of airfoil data. Application, with no optimization, of the WIAC code to fully adapted data has unfortunately been more difficult and time consuming than initially expected from similar previous experience with WIAC application to slotted-wall data. In several instances, however, the WIAC corrections for partially to fully adapted wall airfoil data are shown to be significantly smaller than those for comparable straight, solid- and slotted-wall cases. This indicates a lesser degree of wall interference present in these adapted wall cases. Author

N88-21130 Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
5 Jun. 1987 112 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-023) Copyright Avail: Issuing Activity

Translated scientific and technological articles from Chinese journals and books are presented. The areas of concern are: Aerospace; Applied sciences; and National developments For individual titles, see N88-21131 through N88-21138.

N88-21131 Joint Publications Research Service, Arlington, Va.
PRC SPACE SATELLITE ACHIEVEMENTS HIGHLIGHTED c18
Chunting Zhang *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 1-5 Transl. into ENGLISH from Liaowang Overseas Edition (Hong Kong, People's Republic of China), no. 17, 27 Apr. 1987 p 14-15 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

Since the first Chinese experimental communications satellite was launched in April 1984 and fixed in the sky over the equator at Longitude 125 deg East, it has been moving normally in orbit for 3 years, fulfilling or overfulfilling the target of 3 year work life stipulated by the original plan and experimental outline. The accomplishments of the space satellite are detailed. E.R.

N88-21132 Joint Publications Research Service, Arlington, Va.
INCOMPRESSIBLE THEORY OF INTERACTION BETWEEN MOVING BODIES AND VORTICITY FIELD: FORCE ON MOVING BODIES BY VORTICITY FIELD Abstract Only c34
Jiezhi Wu *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 30 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 22-30 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

An incompressible theory of the interaction between moving bodies and the vorticity field is given. It is shown that the action of incompressible fluids on moving bodies can be attributed to the reaction of the vorticity generated by the bodies in a way precisely corresponding to that in which the bodies generate vorticity. In particular, for a uniformly moving three dimensional body, the total force just equals the surface integral of the vectorial moment of local vorticity flux, with the remaining effects being completely cancelled. These results not only provide a deeper understanding of the mechanism of interaction between bodies and fluids, but also suggest a new possible approach toward improving the force characteristics by some local design. Author

N88-21133 Joint Publications Research Service, Arlington, Va.
TRANSONIC FLOW FIELD ANALYSIS FOR REAL FUSELAGE CONFIGURATIONS Abstract Only
Zhaoqian Wang *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 31 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 31-37 Original language document was announced in IAA as A87-37554 (For primary document see N88-21130 14-02)
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The modified small disturbance equation is solved by a relaxed-line method. Crude and fine grid systems are used alternatively in the solving process. Engquist-Osher and Jameson difference schemes are combined, and the lateral relaxed-line method is used at local lines of the fuselage side. Faster convergence is obtained in a numerical experiment using this method. Several examples prove that fewer interactions are required, and that computing results agree with experimental results quite well. Author

N88-21134 Joint Publications Research Service, Arlington, Va.
DATA PROCESSING METHOD FOR HIGH ANGLE OF ATTACK TESTING WITH ROLLING ANGLE Abstract Only
Guiqing Jiang *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 32 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 55-61 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

A method and formulas for aerodynamic coefficient and model attitude transform, elastic deflections and flow deviation angle correction in testing with a rolling angle were developed. The simple and quick method and detailed procedure used to obtain longitudinal and lateral aerodynamic plots based on the testing data are presented. An accurate and simple method for calculating the real attitude of the model without solving nonlinear equations and with which the testing can be carried out according to the preset attitudes is also presented. Author

N88-21135 Joint Publications Research Service, Arlington, Va.
RESEARCH ON FLOW AROUND BLUFF BODIES, FLOW INDUCED VIBRATIONS Abstract Only c34
Tianfeng Sun and Erjie Cui *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 33 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 62-75 (For primary document see N88-21130 14-02)
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The flow around bluff bodies and the related flow induced vibrations are reviewed. The emphasis is placed on investigations of the flow around a circular cylinder and rectangular prism, and the interference between the two cylinders in various arrangements. The effects of body oscillation, incident shear and flow turbulence are discussed in detail. Some specific problems remaining to be solved are also identified. Author

N88-21136 Joint Publications Research Service, Arlington, Va.
PROPAGATION OF ARTIFICIAL DISTURBANCES IMMERSED IN THICK TURBULENT BOUNDARY LAYER Abstract Only c34
Xiao Ming and H. U. Meier *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 34 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 76-81 Original language document was announced in IAA as A87-37559 (For primary document see N88-21130 14-02)
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In wind tunnel tests, trip wires or local surface roughness are often applied to fix the boundary layer transition on airfoils or wings. The propagation of such artificial disturbances, immersed in a turbulent boundary layer, on a flat wind tunnel side wall is investigated at zero and adverse pressure gradient. It was found that the momentum loss resulting from boundary layer disturbance remains in the boundary layer downstream. In zero pressure gradient flow, this local momentum loss is almost an additive constant quantity. On the other hand, an adverse pressure gradient results in amplification of this momentum loss. The boundary layer disturbances resulting from wires of different diameters and locations can be quantified. Author

N88-21137 Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL RESEARCH ON CENTER OF PRESSURE OF SLENDER BODY WITH TWO POINTED ENDS Abstract Only
Quyao Jia *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 35 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 82-87 Original language document was announced in IAA as A87-37560 (For primary document see N88-21130 14-02)
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Using static stability characteristics, the center of pressure for a slender body with two pointed ends was measured. It was verified by low speed experiments that the slender body theory with cross flow can be used accurately to calculate the center of pressure for this kind of body. Author

N88-21138 Joint Publications Research Service, Arlington, Va.
NEW DEFINITION OF PRESSURE-CENTER COEFFICIENT OF REENTRY CRAFT WITH ASYMMETRICAL CONFIGURATION Abstract Only
Yuhe Ren *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 36 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 93-96 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

A new definition of the pressure center coefficient of a reentry craft with asymmetrical configuration without yaw is presented. It is used to calculate the pressure center coefficients of this type of reentry craft. The results show that its pressure center coefficient changes continuously with the attack angle, i.e., it no longer has discontinuity in the form of infinity. The original definition of the pressure center coefficient of the reentry craft with axisymmetrical configuration is only the specific application of the new definition to the reentry craft with the axisymmetrical configuration. Author

N88-21139*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INFLOW MEASUREMENT MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 2: RECTANGULAR PLANFORM BLADES AT AN ADVANCE RATIO OF 0.23
Joe W. Elliott, Susan L. Althoff, and Richard H. Sailey (PRC Kentron, Inc., Hampton, Va.) Apr. 1988 391 p
(NASA-TM-100542; NAS 1.15:100542; AVSCOM-TM-88-B-005)
Avail: NTIS HC A17/MF A01 CSCL 01A

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at NASA Langley Research Center to measure the inflow into a scale model helicopter rotor in forward flight (mu sub infinity = 0.23). The measurements were made with a two-component Laser Velocimeter (LV) one chord above the plane formed by the path of the rotor tips (tip path plane). A conditional sampling technique was employed to determine the azimuthal position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 180 separate locations in order to clearly define the inflow character. This data is presented without analysis. Author

N88-21773# Joint Publications Research Service, Arlington, Va.
EFFECT OF FLOW CONVERGENCE ON TURBULENCE LEVEL IN STREAM Abstract Only
G. I. Derbunovich, A. S. Zernskaya, Ye. U. Repik, and Yu. P. Sosedko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 21 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 2, Mar. - Apr. 1987 p 146-152 Original language document was announced in IAA as

A87-41846 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-21140# Royal Aircraft Establishment, Farnborough (England).
EQUIPMENT TEST METHODS FOR EXTERNALLY PRODUCED ELECTROMAGNETIC TRANSIENTS
R. A. Hobbs Jul. 1987 36 p
(RAE-TM-FS(F)-457; BR104087; ETN-88-92042) Copyright
Avail: NTIS HC A03/MF A01

Test methods to simulate the effect of electromagnetic pulse and lightning strike produced transients to aircraft systems are described. ESA

N88-21141 Civil Aviation Authority, London (England).
UK AIRMISS STATISTICS
Nov. 1987 9 p
(Rept-3/87; ISSN-0951-6301; ETN-88-92056) Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom, 1 pound

Airmiss statistics from 1977 to April 1987 for United Kingdom airspace are presented. ESA

N88-21142 Civil Aviation Authority, London (England).
LAPWINGS AND BIRDSTRIKES. THE BIOLOGY OF THE LAPWING VANELLUS VANELLUS IN RELATION TO THE BIRDSTRIKE HAZARD IT PRESENTS
T. P. Milsom and J. B. A. Rochard Dec. 1987 93 p Sponsored by the United Kingdom Ministry of Defence Prepared in cooperation with the Ministry of Agriculture, Fisheries and Food, London, United Kingdom
(CAA-Paper-87015; ISBN-0-86-039327-5; ETN-88-92058)
Copyright Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom, 7.25 pounds

The ecology and behavior of the lapwing in and around Great Britain were studied. Diurnal and seasonal variations in lapwing-aircraft collisions are discussed. Countermeasures to make aerodromes safe from the lapwing hazard are considered. ESA

N88-21143*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
AN EXPERIMENTAL AND THEORETICAL STUDY OF THE ICE ACCRETION PROCESS DURING ARTIFICIAL AND NATURAL ICING CONDITIONS Final Contractor Report
Mark S. Kirby and R. John Hansman Apr. 1988 136 p
(Grants NAG3-666; NGL-22-009-640)
(NASA-CR-182119; NAS 1.26:182119; DOT/FAA/CT-87/17)
Avail: NTIS HC A07/MF A01 CSCL 01C

Real-time measurements of ice growth during artificial and natural icing conditions were conducted using an ultrasonic pulse-echo technique. This technique allows ice thickness to be measured with an accuracy of + or - 0.5 mm; in addition, the ultrasonic signal characteristics may be used to detect the presence of liquid on the ice surface and hence discern wet and dry ice growth behavior. Ice growth was measured on the stagnation line of a cylinder exposed to artificial icing conditions in the NASA Lewis Icing Research Tunnel (IRT), and similarly for a cylinder exposed in flight to natural icing conditions. Ice thickness was observed to increase approximately linearly with exposure time during the initial icing period. The ice accretion rate was found to vary with cloud temperature during wet ice growth, and liquid runback from the stagnation region was inferred. A steady-state energy balance model for the icing surface was used to compare heat transfer characteristics for IRT and natural icing conditions. Ultrasonic measurements of wet and dry ice growth observed in the IRT and in flight were compared with icing regimes predicted by a series of heat transfer coefficients. The heat transfer magnitude was generally inferred to be higher for the IRT than for the natural icing conditions encountered in flight. An apparent variation in the heat transfer magnitude was also observed for flights conducted through different natural icing-cloud formations. Author

N88-21144*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
INVESTIGATION OF THE MISFUELING OF RECIPROCATING PISTON AIRCRAFT ENGINES
J. Holland Scott, Jr. Mar. 1988 82 p
(NASA-TP-2803; NAS 1.60:2803) Avail: NTIS HC A05/MF A01 CSCL 01C

The Aircraft Misfueling Detection Project was developed by the Goddard Space Flight Center/Wallops Flight Facility at Wallops Island, Virginia. Its purpose was to investigate the misfueling of reciprocating piston aircraft engines by the inadvertent introduction of jet fuel in lieu of or as a contaminant of aviation gasoline. The final objective was the development of a device(s) that will satisfactorily detect misfueling and provide pilots with sufficient warning to avoid injury, fatality, or equipment damage. Two devices have been developed and successfully tested: one, a small contamination detection kit, for use by the pilot, and a second, more sensitive, modified gas chromatograph for use by the fixed-base operator. The gas chromatograph, in addition to providing excellent quality control of the fixed-base operator's fuel handling, is a very good backup for the detection kit in the event it produces negative results. Design parameters were developed to the extent that they may be applied easily to commercial production by the aircraft industry. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-21145# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung HF-Verfahren.
RESULTS OF ONE WAY TRANSIT TIME MEASURING IN NAVIGATION EXPERIMENT NAVEX
Emil Sappl, Herbert Schild, and Anita Zimmermann Aug. 1987 38 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-87-17; ISSN-0176-7739; ETN-88-92116) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 14 Deutsche marks

The task of one way transit time measuring in Spacelab experiment NAVEX during the D1 mission was to measure distances between the shuttle and the ground stations by measuring the transit time of transmitted signals. A set of results of these measurements is presented. ESA

N88-21146 Civil Aviation Authority, London (England).
ELECTRONICS AND COMMUNICATIONS IN AIR TRAFFIC CONTROL: THE PRESIDENTIAL ADDRESS
Frank Chorley 1987 29 p Presented at the Institution of Electronic and Radio Engineers' Annual General Meeting, London, United Kingdom, 13 Oct. 1987
(ETN-88-92057) Avail: Civil Aviation Authority, Greville House, 37 Gratton Road, Cheltenham, United Kingdom

The history and development of air traffic control techniques, particularly the rapid growth in the number of aircraft movements during and after World War 2 are reviewed. The methods employed for safe handling of large volumes of civil and military air traffic in

crowded air space are discussed. The systems of electronic position identification, guidance, and communications used to support the management task are described together with their necessary performance characteristics. The growth predictions for air traffic movements and the demands which this will make upon the existing system performances are examined, and techniques and systems which might be introduced in the future are considered. ESA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

N88-21147# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.

THE COOLING OF ELECTRONIC EQUIPMENT IN FIGHTER AIRCRAFT [KUEHLUNG VON ELEKTRONISCHEN GERAETEN IN KAMPFFLUGZEUGEN]

Werner Senoner 23 Jul. 1986 49 p In GERMAN
(MBB/LKE-312/S/PUB/258; ETN-88-91441) Copyright Avail: NTIS HC A03/MF A01

Cooling systems for avionics purposes are discussed. The design and test requirements for the continuous and intermittent operation of equipment, and the sensitivity of avionics to cooling air temperature are discussed. Climatic conditions in aircraft and avionics are given. The heat dissipation of typical modules and avionics systems is explained. Examples of cooling systems design are presented. ESA

N88-21148# Bristol Univ. (England). Dept. of Aerospace Engineering.

INVESTIGATION INTO THE EFFECTS OF FLAP END MODIFICATIONS ON THE PERFORMANCE OF A WING WITH A SINGLE SLOTTED FLAP B.E. Thesis

J. A. Green and D. A. Wirdnam Jun. 1987 54 p
(BU-357; ETN-88-91897) Avail: NTIS HC A04/MF A01

Aerodynamic balance measurements were employed with probe wake traverses, tuft grid pictures, wool tuft probe investigations, and surface oil film tests to study the possible aerodynamic improvements available by the addition of flap end devices to a wing with a single slotted flap. Flat end plates, winglet style flaplets, flap extensions, and variable span slotted flaps were tested at a constant dynamic pressure of 550 N/m sq (corresponding to a Reynolds number of 600,000 and a tunnel speed of 30 m/sec). To simulate take off conditions the flow visualization was performed at a wing incidence of 8 deg with a flap angle of 19 deg. Balance measurements were taken over a complete incidence range of 0 to 20 deg. The most effective modification, based on an A340 Airbus winglet, improves lift/drag ratio (used as a measure of aerodynamic efficiency) by 2.4 percent at an incidence of 10 deg. ESA

N88-21149# Bristol Univ. (England). Dept. of Aerospace Engineering.

AN INVESTIGATION INTO THE EFFECT OF CANARD LOCATION ON THE AERODYNAMICS OF THE CLOSE-COUPLED CANARD CONFIGURATION B.E. Thesis

I. Marsh and R. K. J. Pratt Jun. 1987 58 p
(BU-361; ETN-88-91901) Avail: NTIS HC A04/MF A01

The aerodynamic interaction of a 50 deg swept back, truncated delta wing and a swept back close-coupled canard was investigated. The all-moving canard had an area of 13.5 percent of the wing area, and its relative position with the wing could be varied from -10 to +20 percent of the wing root chord longitudinally and between 0 and 20 percent normally with respect to the leading edge of the wing. Force measurements were taken for the wing and canard individually in each configuration at a wind speed of 40 m/sec. Results show that aerodynamic interference decreases with increasing longitudinal separation, but the effect of increased normal separation is inconclusive. The total lift of the configurations is only found to be enhanced at very high angles of attack. It must be noted, however, that any effects are small, with the wing C sub L only varying by 5 over the range of positions. ESA

N88-21150# Bristol Univ. (England). Dept. of Aerospace Engineering.

AN INVESTIGATION OF THE SPRAY PRODUCED BY A YAWED WHEEL, INCLUDING MEASUREMENT OF IMPACT FORCES B.E. Thesis

R. J. Semmens and R. M. F. Vaughan Jun. 1987 38 p
(BU-363; ETN-88-91902) Avail: NTIS HC A03/MF A01

The effects of yaw (up to 20 deg) on the spray plumes caused by a wheel running on a flooded runway were studied to produce a correction procedure for estimating spray impact forces from pressure data. Spray was generated at various conditions with a 2000 mm diameter model pneumatic tire, and pressure measurements were made with an intensity probe and an impact-force measuring device. As expected, wheel yaw causes a number of definite asymmetrical effects on the spray plumes. A general correlation between intensity probe data and direct force measurements is obtained, though it is not well defined. Spray pressures of up to 35 psi are recorded at the maximum velocity of 28 m/sec. ESA

N88-21151*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.

DEVELOPMENT OF A REAL-TIME AEROPERFORMANCE ANALYSIS TECHNIQUE FOR THE X-29A ADVANCED TECHNOLOGY DEMONSTRATOR

R. J. Ray, J. W. Hicks, and R. I. Alexander May 1988 18 p Prepared for presentation at the 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100432; H-1471; NAS 1.15:100432) Avail: NTIS HC A03/MF A01 CSCL 01C

The X-29A advanced technology demonstrator has shown the practicality and advantages of the capability to compute and display, in real time, aeroperformance flight results. This capability includes the calculation of the in-flight measured drag polar, lift curve, and aircraft specific excess power. From these elements many other types of aeroperformance measurements can be computed and analyzed. The technique can be used to give an immediate postmaneuver assessment of data quality and maneuver technique, thus increasing the productivity of a flight program. A key element of this new method was the concurrent development of a real-time in-flight net thrust algorithm, based on the simplified gross thrust method. This net thrust algorithm allows for the direct calculation of total aircraft drag. Author

N88-21152*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.

OPERATIONAL VIEWPOINT OF THE X-29A DIGITAL FLIGHT CONTROL SYSTEM

Vince Chacon and David McBride May 1988 11 p Presented at the ISA Aerospace Industries/Test Measurement Divisions 34th International Instrumentation Symposium, Albuquerque, N. Mex., 2-5 May 1988
(NASA-TM-100434; H-1467; NAS 1.15:100434) Avail: NTIS HC A03/MF A01 CSCL 01C

In the past few years many flight control systems have been implemented as full-authority, full-time digital systems. The digital design has allowed flight control systems to make use of many enhanced elements that are generally considered too complex to implement in an analog system. Examples of these elements are redundant information exchanged between channels to allow for continued operation after multiple failures and multiple variable gain schedules to optimize control of the aircraft throughout its flight envelope and in all flight modes. The introduction of the digital system for flight control also created the problem of obtaining information from the system in an understandable and useful format. This paper presents how the X-29A was dealt with during

its operations at NASA Ames-Dryden Flight Research Facility. A brief description of the X-29A control system, a discussion of the tools developed to aid in daily operations, and the troubleshooting of the aircraft are included. Author

N88-21153*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
DEVELOPMENT AND FLIGHT TEST OF AN EXPERIMENTAL MANEUVER AUTOPILOT FOR A HIGHLY MANEUVERABLE AIRCRAFT
Eugene L. Duke, Frank P. Jones, and Ralph B. Roncoli Sep. 1986 61 p
(NASA-TP-2618; H-1258; NAS 1.60:2618) Avail: NTIS HC A04/MF A01 CSCL 01C

This report presents the development of an experimental flight test maneuver autopilot (FTMAP) for a highly maneuverable aircraft. The essence of this technique is the application of an autopilot to provide precise control during required flight test maneuvers. This newly developed flight test technique is being applied at the Dryden Flight Research Facility of NASA Ames Research Center. The FTMAP is designed to increase the quantity and quality of data obtained in test flight. The technique was developed and demonstrated on the highly maneuverable aircraft technology (HiMAT) vehicle. This report describes the HiMAT vehicle systems, maneuver requirements, FTMAP development process, and flight results. Author

N88-21154# Technische Hogeschool, Delft (Netherlands). Vakgroep Constructies, Sterkte en Trillingen.
COMPUTER AIDED DESIGN OF AIRCRAFT STRUCTURES [COMPUTERGESTEUND ONTWERPEN VAN VLIEGTUEG-KONSTRUKTIES]
T. J. vanBaten, J. W. Gunnink, R. R. Hordijk, R. P. Notenboom, and A. Rothwell 13 Jan. 1987 28 p In DUTCH
(ETN-88-91353) Avail: NTIS HC A03/MF A01

The application of computer aided design (CAD) for aircraft structures is outlined, with a view to the education of students. The global optimization of an airfoil construction, the optimization of panels, the distances between ribs and the skin thicknesses, and the application of the finite element method are discussed. The design of an airfoil panel using the drawing system MEDUSA, is explained. Exercises for students are presented. ESA

N88-21155# Royal Aircraft Establishment, Farnborough (England).
RECOMMENDED TEST SPECIFICATION FOR THE ELECTROMAGNETIC COMPATIBILITY OF AIRCRAFT EQUIPMENT
N. J. Carter Nov. 1985 103 p
(RAE-TM-FS(F)-510; BR99101; ETN-88-92043; AD-A188867)
Copyright Avail: NTIS HC A06/MF A01

Test limits and test methods for measurement and determination of the electromagnetic interference characteristics (emission and susceptibility) of the electrical, electronic, and electromechanical equipment to be procured for use in military aircraft are specified. Tests specific to the performance of transmitting and/or receiving equipment are not included. ESA

N88-21156# Royal Aircraft Establishment, Farnborough (England).
A FLIGHT TEST INVESTIGATION INTO FLOW SEPARATION AND STRUCTURAL RESPONSE FOR A TRANSPORT AIRCRAFT AT BUFFET ONSET
S. L. Buckingham Jan. 1987 79 p
(RAE-TR-87006; RAE-FS(B)-256; BR104348; ETN-88-92044)
Copyright Avail: NTIS HC A05/MF A01

Flight measurements of structural accelerations and strains were made in a VC-10 aircraft at buffet onset. Tuft photography was used to identify the different separations which occur at conditions along the buffet boundary. Wind tunnel oil-flow studies, and pressure measurements were compared with the results. Strengths and weaknesses of these methods of buffet prediction are identified. Digital spectral analysis of accelerations and strains proves to be a powerful analysis technique, and reveals the extreme complexity of the structural response. Ten or more structural modes, at frequencies to beyond 20 Hz, are excited. The characteristics and relative importance of the modes depends on flight condition. It is possible to identify changes in response with changes in the location of the separations. However, the complexity of the response, together with limitations in the test aircraft's instrumentation system and the absence of unsteady pressure measurements, preclude a detailed study of the interaction between excitation and response. ESA

N88-21157*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC MECHANICAL PROPERTIES OF 30 X 11.5 - 14.5, TYPE 8 AIRCRAFT TIRES OF BIAS-PLY AND RADIAL-BELTED DESIGN
Pamela A. Davis and Mercedes C. Lopez May 1988 24 p
(NASA-TP-2810; L-16374; NAS 1.60:2810) Avail: NTIS HC A03/MF A01 CSCL 01C

An investigation was conducted to determine the static mechanical properties of a 30 x 11.5 to 14.5, Type 8, bias-ply and radial-belted aircraft tire. The properties measured were the spring rate and damping characteristics of each tire from vertical- and lateral-loading hysteresis loops. Mass moment of inertia tests were also conducted. The results of the study are presented along with a discussion of the advantages and disadvantages of each type of tire. Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-21158# Analytic Sciences Corp., Fairborn, Ohio.
ADVANCED AVIONICS SYSTEM ANALYSIS. MODULAR AVIONICS COST BENEFIT STUDY FORMULATION Final Report, Sep. 1983 - Jan. 1986
William L. Bedzyk, Donald R. Czech, Thomas J. Dickman, Frank S. Gruber, and John F. Myers Feb. 1987 77 p
(Contract F33615-83-C-1053)
(AD-A189019; TASC-J-5043; AFWAL-TR-87-1138) Avail: NTIS HC A05/MF A01 CSCL 09A

This is a technical baseline for a cost benefit analysis of optional features of an advanced modular avionics architecture for the mid-1990s. It provides an outline of a projected life cycle cost for alternate configurations for future avionics (including cost for implementation and supportability). GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-21159*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
PERFORMANCE IMPROVEMENTS OF AN F-15 AIRPLANE WITH AN INTEGRATED ENGINE-FLIGHT CONTROL SYSTEM
Lawrence P. Myers and Kevin R. Walsh May 1988 12 p Presented at the AIAA 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100431; H-1470; NAS 1.15:100431) Avail: NTIS HC A03/MF A01 CSCL 21E

An integrated flight and propulsion control system has been developed and flight demonstrated on the NASA Ames-Dryden

F-15 research aircraft. The highly integrated digital control (HIDEC) system provides additional engine thrust by increasing engine pressure ratio (EPR) at intermediate and afterburning power. The amount of EPR uptrim is modulated based on airplane maneuver requirements, flight conditions, and engine information. Engine thrust was increased as much as 10.5 percent at subsonic flight conditions by uptrimming EPR. The additional thrust significantly improved aircraft performance. Rate of climb was increased 14 percent at 40,000 ft and the time to climb from 10,000 to 40,000 ft was reduced 13 percent. A 14 and 24 percent increase in acceleration was obtained at intermediate and maximum power, respectively. The HIDEC logic performed fault free. No engine anomalies were encountered for EPR increases up to 12 percent and for angles of attack and sideslip of 32 and 11 degrees, respectively. Author

N88-21160*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
UTILIZATION OF PARALLEL PROCESSING IN SOLVING THE INVISCID FORM OF THE AVERAGE-PASSAGE EQUATION SYSTEM FOR MULTISTAGE TURBOMACHINERY
Richard A. Mulac, Mark L. Celestina, John J. Adamczyk, Kent P. Misegades, and Jef M. Dawson (Cray Research, Inc., Mendota Heights, Minn.) 1987 13 p Prepared for the 8th Computational Fluid Dynamics Conference, Honolulu, Hawaii, 9-11 Jun. 1987; sponsored by AIAA Previously announced in IAA as A87-42057
(NASA-TM-89845; E-3508; NAS 1.15:89845) Avail: NTIS HC A03/MF A01 CSCL 21E

A procedure is outlined which utilizes parallel processing to solve the inviscid form of the average-passage equation system for multistage turbomachinery along with a description of its implementation in a FORTRAN computer code, MSTAGE. A scheme to reduce the central memory requirements of the program is also detailed. Both the multitasking and I/O routines referred to are specific to the Cray X-MP line of computers and its associated SSD (Solid-State Disk). Results are presented for a simulation of a two-stage rocket engine fuel pump turbine. Author

N88-21161*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NNEPEQ: CHEMICAL EQUILIBRIUM VERSION OF THE NAVY/NASA ENGINE PROGRAM
Laurence H. Fishbach and Sanford Gordon (Gordon, Sanford, Cleveland, Ohio) 1988 10 p Proposed for presentation at the 1988 International Gas Turbine and Aerospace Congress, Amsterdam, Netherlands, 5-9 Jun. 1988; sponsored by ASME
(NASA-TM-100851; E-4050; NAS 1.15:100851) Avail: NTIS HC A02/MF A01 CSCL 21E

The Navy NASA Engine Program, NNEP, currently is in use at a large number of government agencies, commercial companies and universities. This computer code has bee used extensively to calculate the design and off-design (matched) performance of a broad range of turbine engines, ranging from subsonic turboprops to variable cycle engines for supersonic transports. Recently, there has been increased interest in applications for which NNEP was not capable of simulating, namely, high Mach applications, alternate fuels including cryogenics, and cycles such as the gas generator air-turbo-rocker (ATR). In addition, there is interest in cycles employing ejectors such as for military fighters. New engine component models had to be created for incorporation into NNEP, and it was found necessary to include chemical dissociation effects of high temperature gases. The incorporation of these extended capabilities into NNEP is discussed and some of the effects of these changes are illustrated. Author

N88-21162*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SPATIAL INLET TEMPERATURE AND PRESSURE DISTORTION ON TURBOFAN ENGINE STABILITY
Charles M. Mehalic 1988 19 p Proposed for presentation at the 24th Joint Propulsion Conference, Boston, Mass., 11-13 Jul. 1988; sponsored by AIAA, ASEE, ASME and SAE
(NASA-TM-100850; E-4047; NAS 1.15:100850; AIAA-88-3016)
Avail: NTIS HC A03/MF A01 CSCL 21E

The effects of circumferential and radial inlet temperature distortion, circumferential pressure distortion, and combined temperature and pressure distortion on the stability of an advanced turbofan engine were investigated experimentally at simulated altitude conditions. With circumferential and radial inlet temperature distortion, a flow instability generated by the fan operating near stall caused the high-pressure compressor to surge at, or near, the same time as the fan. The effect of combined distortion was dependent on the relative location of the high-temperature and low-pressure regions; high-pressure compressor stalls occurred when the regions coincided, and fan stalls occurred with the regions separated. Author

N88-21163*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A MICROPROCESSOR-BASED REAL-TIME SIMULATOR OF A TURBOFAN ENGINE
Jonathan S. Litt (Army Aviation Research and Development Command, Cleveland, Ohio.), John C. DeLaat, and Walter C. Merrill 1988 16 p Presented at the 19th Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pa., 5-6 May 1988; sponsored by ISA and IEEE
(NASA-TM-100889; E-4124; NAS 1.15:100889;
AVSCOM-TR-88-C-011) Avail: NTIS HC A03/MF A01 CSCL 21E

A real-time digital simulator of a Pratt and Whitney F 100 engine is discussed. This self-contained unit can operate in an open-loop stand-alone mode or as part of a closed-loop control system. It can also be used in control system design and development. It accepts five analog control inputs and its sixteen outputs are returned as analog signals. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-21164# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain). Dept. de Estructuras y Materiales Estructurales.
SCALE MODEL DEVELOPMENT FOR AEROELASTICITY STUDIES [DESARROLLO DE MODELOS A ESCALA PARA ESTUDIOS AEROELASTICOS]
Rafael GonzaloUgarte 1987 10 p In SPANISH; ENGLISH summary
(ETN-88-91887) Avail: NTIS HC A02/MF A01

Scale models were developed for aeroelastic research, including external stores and flutter active supression areas. The specific design of a C-101 wing model is detailed. The design is based on the application of similitude laws. The list of mass distribution required in the different segments is given. Drawings are presented. ESA

N88-21165# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugversuchstechnik.
INVESTIGATIONS ON HIGHER HARMONIC BLADE PITCH CONTROL AT HELICOPTERS Ph.D. Thesis - Technische Univ., Brunswick, Fed. Republic of Germany
Gert Lehmann Sep. 1987 155 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-36; ISSN-0171-1342; ETN-88-91920) Avail: NTIS HC A08/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 51.50 Deutsche marks

An analytical linear model which describes vibration generation in the harmonics of helicopter rotor blade passage frequency in the low and moderate speed region are derived. For calculation

of optimal control inputs for vibration reduction, different approaches are discussed. A vectorized quality criterion is used to show the control effectiveness and the couplings. The concept, hardware, and testing of a higher harmonic control system at a model rotor are described. ESA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-21166# Instituto Nacional de Tecnica Aeroespacial, Esteban Terradas, Torrejon de Ardoz (Spain). Dept. de Aerodinamica y Navegabilidad.

ENVIRONMENT TEST LABORATORY [LABORATORIO DE ENSAYOS AMBIENTALES]

Julio FernandezPerdido 1987 16 p In SPANISH; ENGLISH summary

(ETN-88-91885) Avail: NTIS HC A03/MF A01

Two laboratories were created to perform tests in simulated environments. The type of mechanical and climatic tests are detailed, indicating the ranges for the different parameters. A general classification is given of the type of tests normally included under the denomination of environmental simulation. The test facilities include space vacuum simulation, thermal cycles under vacuum, salt water corrosion, tropical and Arctic climates, centrifugal accelerations, and vibration control. ESA

N88-21167# Bristol Univ. (England). Dept. of Aerospace Engineering.

DETERMINATION OF CANOPY LOADS FOR A LIGHT AIRCRAFT BY WIND TUNNEL TESTING AND COMPUTER MODELLING B.E. Thesis

T. W. Chapman and T. H. A. Lam Jun. 1987 56 p

(BU-353; ETN-88-91893) Avail: NTIS HC A04/MF A01

The airflow over the canopy of the ARV Super 2 was investigated to determine the resulting loads. Wind tunnel tests used a powered model, whereas computer modeling was only for unpowered flight cases with inviscid flow. Results for the entire range of flight conditions, including power setting are presented. The two methods are compared for both pressure distributions and force coefficients on the canopy. Normal force is seen to be the greatest force acting, overshadowing both side and longitudinal forces. Normal force increases rapidly with velocity and g loading, and also with power setting. The greatest canopy loads occur therefore, at the maximum velocity, power setting, and g loading. The results are applicable to all single-engined, high wing light aircraft. ESA

N88-21168# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

THE 30 X 30 INCH WIND TUNNEL

A. D. Cutler and P. Bradshaw Jun. 1987 15 p

(IC-Aero-87-01; ISSN-0308-7247; ETN-88-91914) Avail: NTIS HC A03/MF A01

A 30 x 30 in. (0.76 x 0.76 m) blower tunnel was improved. The flow in the working section is of good quality, with a free-stream turbulence level of 0.2 percent and total-pressure variations of less than 2 percent over the cross section. These appear to be the best figures obtainable from a blower tunnel with a contraction ratio of only 4:1. Calibration details and advice for operators of this and similar tunnels are included. ESA

N88-21169*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.

DEVELOPMENT OF AN INTEGRATED SET OF RESEARCH FACILITIES FOR THE SUPPORT OF RESEARCH FLIGHT TEST

Archie L. Moore and Constance D. Harney May 1988 17 p Presented at the AIAA 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988

(NASA-TM-100427; H-1458; NAS 1.15:100427; AIAA-88-2095) Avail: NTIS HC A03/MF A01 CSCL 14B

The Ames-Dryden Flight Research Facility (DFRF) serves as the site for high-risk flight research on many one-of-a-kind test vehicles like the X-29A advanced technology demonstrator, F-16 advanced fighter technology integration (AFTI), AFTI F-111 mission adaptive wing, and F-18 high-alpha research vehicle (HARV). Ames-Dryden is on a section of the historic Muroc Range. The facility is oriented toward the testing of high-performance aircraft, as shown by its part in the development of the X-series aircraft. Given the cost of research flight tests and the complexity of today's systems-driven aircraft, an integrated set of ground support experimental facilities is a necessity. In support of the research flight test of highly advanced test beds, the DFRF is developing a network of facilities to expedite the acquisition and distribution of flight research data to the researcher. The network consists of an array of experimental ground-based facilities and systems as nodes and the necessary telecommunications paths to pass research data and information between these facilities. This paper presents the status of the current network, an overview of current developments, and a prospectus on future major enhancements. Author

N88-21170# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.

INVESTIGATION OF THE INTER-RELATIONSHIP BETWEEN BASE PAVEMENT STIFFNESS AND ASPHALT OVERLAY COMPACTION Final Report

Roy D. McQueen Mar. 1988 188 p

(Contract DTFA01-87-P-08001)

(DOT/FAA/ES-88/1) Avail: NTIS HC A09/MF A01

A research project to investigate the degree, if any, that base pavement support influences the compactibility of an asphaltic concrete overlay is summarized. As a secondary objective, the study enabled a comparison of the FAA Eastern Region in-place air voids compaction standard with the FAA National percent Marshall density compaction standard. Field data were collected on three paving projects in FAA's Eastern Region. Nondestructive testing (NDT) was used to quantify the stiffness of base pavements prior to overlay. After overlay construction, the unit weights of the asphalt overlays were determined at the same locations where NDTs were performed, and in-place air voids and percent Marshall densities computed. Statistical techniques were employed to investigate correlations between stiffness and asphaltic concrete density. Although a mild correlation between stiffness and density was found at one project, no general trends were detected for the other projects or from regression analyses on combined data bases. While this may suggest that base pavement stiffness is not a primary variable in affecting overlay compaction on airport pavements, the effect of stiffness may be masked by other external variables, such as temperature, rolling, mix properties, and quality control. Finally, apparent inconsistencies were observed between FAA Eastern Region and FAA National density acceptance plans with regard to acceptable quality level and payment. Author

N88-21171# Technische Univ., Berlin (West Germany). Inst. fuer Luft und Raumfahrt.

DESIGN OF A SOUND NECK IN CONNECTION WITH THE MODEL-SUPPORT SYSTEM OF A TRANSONIC WIND TUNNEL TEST SECTION [GESTALTUNG DES SCHALLHALSES IN VERBINDUNG MIT DEM MODELL-SUPPORT-SYSTEM EINER TRANSSONIK WINDKANAL-MESSTRECKE]

H.-G. Luxa and U. Ganzer Sep. 1987 74 p In GERMAN

(Contract DFG-Ga-123/26-1)

(ILR-Mitt-186(1987); ETN-88-91446) Avail: NTIS HC A04/MF A01

A wind tunnel concept whereby the support sting as central compression body is connected to the second constriction (neck), was investigated with a view to the reduction of the effects of perturbations in the support arrangement on the model flow. The sound neck configuration consists of a fixed-geometry sting profile

and variable wind tunnel walls. The efficiency of this arrangement was verified. The production of perturbations by the profile body, and their suppression by the sound necking at the sting are demonstrated. ESA

N88-21172 British Aerospace Aircraft Group, Preston (England).
THE 5.5 m LOW SPEED WIND TUNNEL. INTRODUCTION TO THE FACILITIES
M. R. Stott 25 Aug. 1987 16 p
(ARG-205; ETN-88-92069) Copyright Avail: British Aerospace PLC, Military Aircraft Division, Warton Aerodrome, Preston PR4 1AX, United Kingdom

A wind tunnel designed specifically for the investigation of the aerodynamics of powered lift VSTOL configurations but, because of the large test section, suitable for high incidence and rotary derivative tests using large scale models of up to 2 m span is presented. The test section speed range normally available is 12 to 20 m/sec in a cross section 5.5 m wide by 5.0 m high by 10 m long. The effect of crosswinds at the intake and exit of the open return tunnel are rendered insignificant by low loss shielding. Upstream of the test section the inlet flow passes through a contraction followed by a honeycomb section and a low loss gauze, to achieve uniform flow. The test section floor has a full span boundary layer suction scoop to facilitate good ground effect representation. A part span moving ground belt may be installed downstream of the suction scoop. It is fitted with a suction pad across its upstream width to inhibit further growth of the floor boundary layer. ESA

N88-21173 British Aerospace Aircraft Group, Preston (England).
MAIN FEATURES OF WARTON (UNITED KINGDOM) 2.7 x 2.1 m LOW SPEED WIND TUNNEL
16 Jul. 1985 9 p
(AXM-124; ETN-88-92070) Copyright Avail: British Aerospace PLC, Military Aircraft Division, Warton Aerodrome, Preston PR4 1AX, United Kingdom

A wind tunnel of the continuous running, atmospheric pressure, closed return type is presented. Tunnel speed is variable between 1 to 67 m/sec. Automatic shutdown can be initiated from a vibration sensor mounted in the model or its mounting. The facility played a major role on the Canberra, Lightning, TSR2, AFVG, Jaguar, and Tornado projects. Low speed measurements of longitudinal and lateral stability, evaluation of effectiveness of controls, development of high lift systems, ground effects, position of air data sensors, store carriage development, jettison work, and intake/duct testing were done. The working section measures 2.7 m wide by 2.1 m high and has 45 deg fillets in each corner giving a 5.1 sqm cross-sectional area. The roof of the working-section is removable to allow insertion of bulky models or supports. The length of the parallel section is 5.48 m. A water tunnel is described. ESA

N88-21174 British Aerospace Aircraft Group, Preston (England).
DETAILS OF LOW SPEED INTAKE TEST FACILITY AT THE WARTON (UNITED KINGDOM) 2.7m x 2.1m WIND TUNNEL
30 Jan. 1986 7 p
(AXM-127; ETN-88-91071) Copyright Avail: British Aerospace PLC, Military Aircraft Division, Warton Aerodrome, Preston PR4 1AX, United Kingdom

An intake/suction rig was designed in order to assess: (1) Inlet internal performance and engine face flow quality by simultaneous measurement of pressure recovery, time variant distortion, swirl and turbulence, for the full range of flight conditions from static/ground running to low speed, and particularly the critical subsonic high incidence and sideslip combinations; (2) Inlet duct performance and flow quality by using an appropriate bellmouth; (3) Intake performance including simulation of the duct, heat exchanger and ejector, with comprehensive diagnostic instrumentation; and (4) Air data system performance. The rig consists of a twin compressed air powered ejector to power the two inlets; a strut mounted keelplate which can be easily adapted to carry various models (typically at 1/5th scale); a comprehensive, 152 mm dia, A/P rake. The 2.7 m x 2.1 m wind tunnel, using this rig, gives speeds from 0 to 45 m/sec and a full range of alpha (-10 to +70 deg) and beta (-15 to +15 deg) to cover all flight conditions in one facility. ESA

N88-21175 British Aerospace Aircraft Group, Preston (England). Military Aircraft Div.
MAIN FEATURES OF THE 0.43m x 0.43m WIND TUNNEL
J. Fisher 1986 4 p
(AXM-132; ETN-88-92072) Copyright Avail: British Aerospace PLC, Military Aircraft Division, Warton Aerodrome, Preston PR4 1AX, United Kingdom

A 0 to 5 m/sec water tunnel using an impellor drive for the higher speeds in the range or a water ejector drive for the lower speeds is presented. It features closed circuit type continuous operation, in a working section 0.43 m square by 1.0 m long, with observations windows 0.5 x 0.3 m on 3 sides of the working section. It has a remotely operated turntable on rear wall of working section to vary one parameter, e.g., incidence, flap angle, or intake flow, and a mercury vapor slit light source to illuminate a single plane of the flow. Test programs include dye filament photography to show flow over a wing/strake combination and over a slender missile to show the fuselage vortices. Particle flow is used to show the flow down an intake to study intake spillage. Similar to this is the hydrogen bubble technique used to show the flow down an intake diverter as well as vortex flow over a delta wing. Wool tufts are used as well as surface oil flow. Pressures may also be measured on a multi-tube manometer. ESA

N88-21176# Royal Air Force Coll., Cranwell (England). Dept. of Transport Technology.
DESIGN OF A SUPERSONIC WIND TUNNEL M.S. Thesis
Colin William Hamilton 1987 135 p
(ETN-88-92078) Avail: NTIS HC A07/MF A01

The possibility of using an existing high pressure air supply to drive a supersonic wind tunnel was verified, and a tunnel was designed. Comparison of the direct drive and induced flow tunnels shows that an induced flow design is significantly larger and, therefore, more suitable for the demonstration use intended. After considering wind tunnel features including nozzle geometry, working section layout, injector box design, diffuser performance, and boundary layer effects, the design of an induced flow wind tunnel evolved. The design consists of a supersonic demonstration tunnel operating at Mach 1.6 with a working section which has a cross-section of 1.875 by 0.8 in. ESA

N88-21177*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
THE NASA INTEGRATED TEST FACILITY AND ITS IMPACT ON FLIGHT RESEARCH
D. A. Mackall, M. D. Pickett, L. J. Schilling, and C. A. Wagner May 1988 16 p Presented at the 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100418; H-1446; NAS 1.15:100418) Avail: NTIS HC A03/MF A01 CSCL 14B

The Integrated Test Facility (ITF), being built at NASA Ames-Dryden Flight Research Facility, will provide new test capabilities for emerging research aircraft. An overview of the ITF and the challenges being addressed by this unique facility are outlined. The current ITF capabilities, being developed with the X-29 Forward Swept Wing Program, are discussed along with future ITF activities. Author

N88-21178# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
F-16 SIMULATOR FOR MAN-IN-THE-LOOP TESTING OF AIRCRAFT CONTROL SYSTEMS (SIMTACS) M.S. Thesis
Mark W. Kassan Dec. 1987 176 p
(AD-A189675; AFIT/GE/ENG/87D-30) Avail: NTIS HC A09/MF A01 CSCL 01D

The focus of this project is the development of a real-time flight simulator for man-in-the-loop evaluation of flight control system designs. The F-16A is the simulated aircraft and a simplified F-16 digital flight control system is used. The simulations model

nonlinear aerodynamic data over most of flight envelope and nonlinear inertially cross-coupled aircraft dynamics. The simulator is implemented on two Electronic Associates, Inc. SIMSTAR hybrid computer systems and an initial cockpit is designed for human pilot interactions. The simulated aircraft dynamic behavior is validated using AFTI/F-16 closed-loop time responses provided by the Air Force Flight Dynamics Laboratory. The real-time, man-in-the-loop simulator is designed using the SIMSTAR computer systems. Currently, the simulator performance is limited in the speed of response. This temporary lack of speed is the result of the computational limitations of the current digital processors of the SIMSTAR computer systems. These limitations can be removed with hardware upgrades. GRA

N88-21351# Joint Publications Research Service, Arlington, Va.
CHINA CONSTRUCTING HIGH-ALTITUDE TEST CELL
Daxiang Liu and Hanzhong Zhou *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 1-5 Transl. into ENGLISH from Guoji Hangkong (Beijing, Peoples Republic of China), no. 6, Jun. 1987 p 20-21, 56 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-21179# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
THE GERMAN SPACELAB MISSION D1: PAYLOAD INTEGRATION Final Report [DEUTSCHE SPACELAB-MISSION D1. NUTZLASTINTEGRATION]
Paul Athmann, Hans-D. Clores, Heinz Hadler, Wolfgang Haebel, Stefan Koschade, Hiltrud Pieterek, Holger Renken, Gernot Schmidt, Hans-W. Usedom, and Horst Xekerle 1987 138 p In GERMAN Original document contains color illustrations
(Contract BMFT-01-QV-252-AK-SN)
(ETN-88-91507) Avail: NTIS HC A07/MF A01

The different payload elements and single experiments of the D1 payload integration were put together. The main research activities are described, i.e., systems accommodation, computer software, mission-specific hardware and rack-integration, integration tests, stowage, configuration control, and transportation. The mission is discussed with a view to the function of the developed apparatus and hardware components, as well as to the ground station activities. ESA

N88-21180# Technische Univ., Berlin (West Germany). Inst. fuer Luft- und Raumfahrt.
EUROPEAN PROGRESS ON SPACE (EPOS): PARTICIPATION IN THE CREATION OF LONG TERM EUROPEAN SPACE PROGRAMS [EPOS EUROPEAN PROGRESS ON SPACE. EIN BEITRAG ZUR GESTALTUNG EINES LANGFRISTIGEN, EUROPAEISCHEN RAUMFAHR-TPROGRAMMES]
Uwe Apel 1 Oct. 1987 82 p In GERMAN; ENGLISH summary
(ILR-Mitt-189; ETN-88-92118) Avail: NTIS HC A05/MF A01

European space program options for the next 50 yr were analyzed. Criteria for space program creation were developed. Based on these criteria and different estimates of future development of European resources for space, three space programs are compared using a value-analysis approach. It is shown that the resulting program is highly constrained by restrictions given by the necessary sequence of projects and the maximum available yearly budget. Large programs yield more worth than small ones but the cost/worth ratio grows with program size during the considered 50 yr horizon. This increase in the cost/worth ratio can partly be explained by the long time lag between start and return of value of big projects. ESA

N88-21181# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EVALUATION OF THE METHODS FOR RESCUING EVA (EXTRAVEHICULAR ACTIVITIES) CREWMEMBERS AND RECOVERING EQUIPMENT DETACHED AND ADRIFT FROM THE SPACE STATION M.S. Thesis
Thomas Selinka Dec. 1987 130 p
(AD-A189683; AFIT/GSO/AA/87D-4) Avail: NTIS HC A07/MF A01 CSCL 22A

This thesis is an analysis of the methods for extravehicular activity (EVA) crew rescue and recovery of equipment detached and adrift from the space station. This top level analysis is aimed at identifying the proper direction to be taken in finding the solution system to the rescue/recovery problems. Results of the analysis indicate that for short range rescue/recovery operations, both an EVA self rescue device and a space station supported device are the preferred solution systems. For medium range rescue/recovery operations, an unmanned free-flyer is the ideal solution system. Finally, for long range operations, the Orbital Maneuvering Vehicle (OMV) is the preferred solution. The analysis also showed that the combination of all these preferred solutions is needed to completely solve the problems. To this end, the analysis provides an example of a comprehensive rescue/recovery system. Finally, the analysis identifies issues and recommends areas which require further analysis in order to fully understand and solve the problems of EVA crew rescue and recovery of equipment detached and adrift from the space station. GRA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N88-21182# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
SEASAT ORBIT DETERMINATION EXPERIMENTS IN PREPARATION FOR THE ERS-1 ALTIMETRY MISSION
K. F. Wakker, R. C. A. Zandbergen, and B. A. C. Ambrosius 1987 26 p Presented at the AAS/AIAA Astrodynamics Specialist Conference, Kalispell, Mont., 10-13 Aug. 1987 Revised Sponsored by the Netherlands Space Research Organization, Utrecht
(ETN-88-91842) Avail: NTIS HC A03/MF A01

Techniques to generate highly accurate orbits for ERS-1, and to process the satellite's radar altimeter measurements were investigated. To test numerical techniques, the orbit of Seasat was recomputed using state-of-the-art dynamic models. It is demonstrated that the Seasat rms radial orbit error is 0.9 to 1.1 m for 3-day arcs computed from laser tracking data and applying the PGS-S4 Seasat-tailored gravity and station coordinates models. With the GEM-T1 gravity model in combination with the UT/CSR LSC 8402 laser station coordinates an improvement is observed: rms radial orbit error decreases to 0.6 m for the same arc length and tracking network. It is expected that through further improvement of gravity and other dynamic models the radial component of the Seasat orbit may be computed with an rms accuracy of 0.4 m. It is also demonstrated that the radial accuracy of orbits computed from laser range observations acquired by only one laser station in combination with altimeter cross-over height differences may be just as good as the accuracy of orbits computed from laser range observations acquired by a global network of laser stations. For many oceanographic applications of the altimeter data the indicated orbit accuracy levels are, however, still too low, but improvement is possible. ESA

N88-21183*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
IMP 7 (EXPLORER 47) TRAJECTORY, SEPTEMBER 26, 1972 TO SEPTEMBER 25, 1978
Pamela A. Milligan and Alan J. Lazarus 21 Apr. 1988 366 p
(Grant NGL-22-009-015)

(NASA-CR-182697; NAS 1.26:182697; CSR-TR-88-3) Avail: NTIS HC A16/MF A01 CSCL 22C

The trajectory plots for IMP 7 (Explorer 47) are contained. For each orbit the trajectory is shown in five panels on two pages; each panel is a different representation or projection. The trajectory parameters were obtained from the multi-coordinate ephemeris (MCE) tapes supplied to IMP experimenters by the IMP project. The plots on the right hand pages use a geocentric, solar-ecliptic coordinate system. Distances are in units of earth radii. The plots on the left hand pages use geocentric, solar magnetospheric coordinates with distances in earth radii. Author

N88-21184# Royal Aircraft Establishment, Farnborough (England).

UNIVERSAL PROCEDURES FOR CONVERSION OF ORBITAL ELEMENTS TO AND FROM POSITION AND VELOCITY (UNPERTURBED ORBITS)

R. H. Gooding Jun. 1987 47 p

(RAE-TR-87043; RAE-Space-669; BR103779; ETN-88-92047)

Copyright Avail: NTIS HC A03/MF A01

Universally applicable algorithms for converting from orbital elements to position and velocity, and vice versa are presented. Though the element set is universal, the algorithms distinguish internally between six types of orbit, three of them rectilinear, since this leads to maximum efficiency and accuracy. The element set is not free from singularity, but it is shown that this does not detract from the universal validity of the computing procedures that implement the algorithms. Because of the importance of singularities in other contexts, however, a convenient method of dealing with them, when necessary, is described. The algorithm that converts from elements to position and velocity requires the solution of Kepler's equation for elliptic orbits, and the analogous equation for hyperbolic orbits. ESA

N88-21185# Royal Aircraft Establishment, Farnborough (England).

ANALYSIS OF THE ORBIT OF COSMOS 1335 (1982-07A) AT 3:12 RESONANCE

A. N. Winterbottom, M. R. Suttie, and D. G. King-Hele Jun. 1987 23 p

(RAE-TR-87041; RAE-SS-2; BR103852; ETN-88-92049)

Copyright Avail: NTIS HC A03/MF A01

Cosmos 1335 (1982-07A) was launched on 29 January 1982 into a near-circular orbit of inclination 74 deg., and decayed on 5 April 1987. The orbit has been determined from observations for 26 epochs between September 1985 and May 1986, a time when the orbit was experiencing the effects of 31:2 resonance with the Earth's gravitational field. About 1400 observations were used, the most numerous being those from the U.S. Navy Navspasur system, and the most accurate those from the Hewitt cameras of the University of Aston sited at Herstmonceux and at Siding Spring in Australia. The average orbital accuracy achieved was about 70 m radial and 120 m cross-track. Analysis of the changes in inclination and eccentricity at resonance has yielded useful values for six lumped harmonics in the geopotential of order 31: the two lumped harmonics of even degree had an average accuracy equivalent to 1.5 cm in geoid height; the four of odd degree had accuracies between 2 and 7 cm. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-21186*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MIXING FUEL PARTICLES FOR SPACE COMBUSTION RESEARCH USING ACOUSTICS

Robert J. Burns, Jerome A. Johnson, and Robert B. Klimek 1988 16 p Presented at the 2nd International Symposium on Experimental Methods for Microgravity Materials Science Research, Phoenix, Ariz., 25-29 Jan. 1988; sponsored by the Metallurgical Society of AIME

(NASA-TM-100295; E-3943; NAS 1.15:100295; AIME-A88-23)

Avail: NTIS HC A03/MF A01 CSCL 21B

Part of the microgravity science to be conducted aboard the Shuttle (STS) involves combustion using solids, particles, and liquid droplets. The central experimental facts needed for characterization of premixed quiescent particle cloud flames cannot be adequately established by normal gravity studies alone. The experimental results to date of acoustically mixing a prototypical particulate, lycopodium, in a 5 cm diameter by 75 cm long flame tube aboard a Learjet aircraft flying a 20 sec low gravity trajectory are described. Photographic and light detector instrumentation combine to measure and characterize particle cloud uniformity. Author

N88-21216# Milan Univ. (Italy).

MECHANICAL DESIGN OF A ULTRAHIGH GRAVITY UHV FACILITY TO LAUNCH AND RECOVER A LOW-SPEED PROJECTILE TESTED ON BOARD KC 135

G. Poletti and D. Cambiaghi (Centrotecnica, Milan, Italy) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 197-203 Sponsored by Piano Spaziale Nazionale-CNR (For primary document see N88-21191 14-18)

Copyright Avail: NTIS HC A14/MF A01

N88-21224# European Space Tribology Lab., Risley (England). Northern Research Labs.

A TEST FACILITY FOR THE IN-VACUO ASSESSMENT OF DRY LUBRICANTS AND SMALL MECHANISMS AT CRYOGENIC TEMPERATURES

E. W. Roberts, S. G. Gould, J. A. Duvall, and P. McDonald (Southampton Univ., England) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 253-259 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)

Copyright Avail: NTIS HC A14/MF A01

N88-21228# Societe Nationale Industrielle Aerospatiale, Cannes (France). Cryogenic Lab.

CRYOGENIC TEST FACILITIES FOR AN OPTICAL CRYOMECHANISM QUALIFICATION

S. Taride *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 281-284 (For primary document see N88-21191 14-18)

Copyright Avail: NTIS HC A14/MF A01

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-21187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COSPAS-SARSAT SATELLITE ORBIT PREDICTOR. VOLUME 11: ALMANAC, 16 OCTOBER 1987 - 15 APRIL 1988

Morton L. Friedman Oct. 1987 107 p

(NASA TM-85015-Vol-11; Rept-87B0289-Vol-11; NAS 1.15:85015-Vol-11) Avail: NTIS HC A06/MF A01 CSCL 22A

The satellite orbit predictor is a graphical aid for determining the relationship between the satellite (COSPAS or SARSAT) orbit, antenna coverage of the spacecraft and coverage of the local user terminals (LUT). The predictor allows the user to quickly visualize if a selected position will probably be detected and is composed of a base map and a satellite track overlay for each

satellite. Additionally, a table of equator crossings for each satellite is included. M.G.

N88-21188*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPACE STATION HEAVY LIFT LAUNCH VEHICLE UTILIZATION Technical Memorandum, Jan. - Dec. 1987
L. J. DeRyder Apr. 1988 177 p
(NASA-TM-100604; NAS 1.15:100604) Avail: NTIS HC A09/MF A01 CSCL 22B

The use of Heavy Lift Launch Vehicles (HLLVs) for Space Station assembly, logistics. and resupply is explored. Potential HLLVs, including those based on the Titan, and Shuttle-derived vehicles (SDV), are discussed. The baseline Critical Evaluation Task Force (CETF) Space Station assembly sequence is described and compared with assembly options made possible through the use of HLLVs. The issues of cost, dual compatibility with the Space Shuttle Space Transportation System (STS), co-manifesting of payloads with other science missions cargo return, and ground handling and launch facilities are also considered. The main advantage achieved by using HLLVs are simplification of assembly procedures, added resupply capability, and increased assured access to space. The major disadvantages are increased orbital flight operations complexity, higher logistics costs, and additional ground handling/launch facility requirements. Also, there will not be any improvement in return cargo capacity, nor any addition to crew transport capabilities. Finally, the dual STS/HLLV compatibility should be maintained to minimize program risk. HLLV and Orbital Maneuvering Vehicle design must parallel that of the Space Station. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N88-21199# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PAYLOAD DEPLOYMENT SYSTEM
J. A. Remus and J. P. Birkedal *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 53-58 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21234# Sener S.A., Madrid (Spain).
OLYMPUS SHUTTLE SPECIFIC RADIATOR SHIELD
C. Pascual and F. Artigas *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 327-332 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21488*# Astro Aerospace Corp., Carpinteria, Calif.
SPACE STATION MOBILE TRANSPORTER
James Renshall, Geoff W. Marks, and Grant L. Young *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 271-286 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

N88-21496*# Lockheed Space Operations Co., Cocoa Beach, Fla.
MODIFICATION AND DEVELOPMENT OF THE EXTERNAL TANK HYDROGEN VENT UMBILICAL SYSTEM FOR THE SPACE SHUTTLE VEHICLE
Bemis C. Tatem, Jr. *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 401-410 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N88-21189*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECT OF ATMOSPHERIC TURBULENCE ON THE BIT ERROR PROBABILITY OF A SPACE TO GROUND NEAR INFRARED LASER COMMUNICATIONS LINK USING BINARY PULSE POSITION MODULATION AND AN AVALANCHE PHOTODIODE DETECTOR
H. G. Safren Aug. 1987 58 p
(NASA-TM-100699; Rept-86B0541; NAS 1.15:100699) Avail: NTIS HC A04/MF A01 CSCL 09F

The effect of atmospheric turbulence on the bit error rate of a space-to-ground near infrared laser communications link is investigated, for a link using binary pulse position modulation and an avalanche photodiode detector. Formulas are presented for the mean and variance of the bit error rate as a function of signal strength. Because these formulas require numerical integration, they are of limited practical use. Approximate formulas are derived which are easy to compute and sufficiently accurate for system feasibility studies, as shown by numerical comparison with the exact formulas. A very simple formula is derived for the bit error rate as a function of signal strength, which requires only the evaluation of an error function. It is shown by numerical calculations that, for realistic values of the system parameters, the increase in the bit error rate due to turbulence does not exceed about thirty percent for signal strengths of four hundred photons per bit or less. The increase in signal strength required to maintain an error rate of one in 10 million is about one or two tenths of a db. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-21190*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A 60-METER ERECTABLE ASSEMBLY CONCEPT FOR A CONTROL OF FLEXIBLE STRUCTURES FLIGHT EXPERIMENT
Judith J. Watson and Walter L. Heard, Jr. Feb. 1988 20 p
(NASA-TM-100497; NAS 1.15:100497) Avail: NTIS HC A03/MF A01 CSCL 22B

A flight experiment which proposes to use a 60-m deployable/retractable truss beam attached to the Space Shuttle to study dynamic characterization and control of flexible structures is being studied by NASA. The concept requires a relatively complex mechanism for deploying and retracting the truss on-orbit. Development of such a mechanism having a high degree of reliability will be expensive. An alternative method for constructing the truss is discussed requiring no new technology development or complex mechanisms and has already been demonstrated on-orbit. The alternative method proposes an erectable truss beam which can be assembled by two astronauts in EVA. The EVA crew would have to manually assemble the beam from 468 struts and 165 nodes, and install 7 instrumentation platforms with signal and power cabling. The predicted assembly time is 3 hr and 23 min. The structure would also have to be disassembled and restowed following testing, thus 2 EVA days would be required.

To allow 25 hr for data collection (probably a bare minimum to accomplish meaningful tests), current Shuttle operations policy dictates a 9-day mission. The design, assembly procedure and issues associated with the alternative concept are discussed.
Author

N88-21191# European Space Agency, Paris (France).
PROCEEDINGS OF THE 3RD EUROPEAN SPACE MECHANISMS AND TRIBOLOGY SYMPOSIUM
J. Hunt, ed. Dec. 1987 324 p Symposium held in Madrid, Spain, 30 Sep. - 2 Oct. 1987; sponsored by Sener S.A., ESA, and Escuela Tecnica Superior de Ingenieros Aeronauticos
(ESA-SP-279; ISSN-0379-6566; ETN-88-91973) Copyright Avail: NTIS HC A14/MF A01

Spacecraft pointing mechanisms, booms, deployable structures, latches, tribology, components and instruments, and testing were discussed. For individual titles, see N88-21192 through N88-21234.

N88-21192# Ball Aerospace Systems Div., Boulder, Colo.
CRRES CHEMICAL RELEASE MECHANISMS
C. Hoffman *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 5-9 (For primary document see N88-21191 14-18)
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The Combined Release and Radiation Effects Satellite (CRRES) is described. The CRRES will use plasma tracing to study the Earth's magnetic field. The chemical payload subsystem to produce the plasmas consists of 2 sizes of canisters (48 total), their individual eject mechanisms, and their carrier modules. Satellite system level requirements are met with a lightweight, simple, and reliable module which allows off-line processing of the chemical payload. It is shown how the ejection velocities were estimated and verified for the spring ejected canisters shooting from a spinning spacecraft. Lubricant data, collected during a search for a vacuum stable, electrically conductive lubricant is presented. The complications involved in predicting the effects of allowing rattle space between the canisters and their guide tubes, and how tests were used to isolate these effects, are outlined. ESA

N88-21193# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
HEMISPHERICAL POINTING MECHANISM DRIVE UNIT c37
H. H. Schultz *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 11-14 (For primary document see N88-21191 14-18)
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A wide angle pointing device for controlling medium sized instrument and antenna payloads in the 10 to 50 kg range for missions requiring angular coverage of at least a hemisphere with a pointing accuracy of the order of 1 arcmin was developed. The drive unit which is the main part of the Hemispherical Pointing Mechanism (HPM) is a lightweight, pancake shaped package. It contains the motor, the reduction gear, the bearing, and the angular encoder. Results of a life test and breadboard model tests are presented. The HPM drive unit demonstrates that it can be used not only in the HPM but also for applications such as antenna pointing, bearing and power transfer, momentum wheel gimballing, control moment gyros, and robotics. ESA

N88-21194# Societe Nationale Industrielle Aerospatiale, Cannes (France).
A POINTING MECHANISM FOR INTERSATELLITE LINK SYSTEM
M. Pastorino and R. Salome (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 15-18 (For primary document see N88-21191 14-18)
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A 15 deg antenna pointing mechanism (APM) for a data relay satellite, based on a roller screw lubricated with a low vapor pressure oil was developed. Accuracy is 0.1 deg for acquisition, 0.01 deg for tracking. Acquisition time is under 120 sec. Operational mode is with the mechanism in closed loop with a resolver on each actuator for acquisition, and mechanism in open loop, but in closed loop at spacecraft level for tracking. The functional principle of the APM is two independent rotations about two orthogonal axes as in the universal joint. It consists of a structure made of two platforms (one fixed and the other mobile) on which the central pivot, the actuators and the blocking device are fixed; the central pivot, a ball bearing universal joint, which enables the X and Y rotations; and an actuation system consisting of two identical screw-jack type actuators which position the mobile platform with regard to the fixed one. ESA

N88-21195# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
SOME HIGHLIGHTS ON ROSAT MECHANISMS c37
P. Pawlowski and H. Heimerdinger (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 21-25 (For primary document see N88-21191 14-18)
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The ROSAT antenna boom mechanism (ABM), and telescope door mechanism (TDM) are described. The ABM is a 3.5 m long CFRP tube with 80 mm outer diameter and 4.5 mm wall thickness. It carries an S-band communication antenna at the tip, and a magnetometer for attitude measurements in the middle. It is stowed for launch and released by a kick spring, which causes a 180 deg rotation of the boom. Latching stubs bolted to the hinge bracket fix it in position. The TDM is used to avoid contamination of the gold coated X-ray mirrors before use. In orbit it is opened by a pyrotechnical device/kick spring, by a 90 deg rotation and acts as a sun shade. ESA

N88-21196# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE CTM PROGRAM OF MASTS AND THE CTM ENGINEERING MODEL c37
M. Aguirre, R. Bureo, F. delCampo, and M. Fuentes (Sener S.A., Madrid, Spain) *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 27-35 (For primary document see N88-21191 14-18)
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A biconvex tube mast that can be flattened and then rolled up around a drum into a small volume package was developed. A drive system pulls the tube by the edges to deploy it. The mast can be manufactured in metal and composite; in both cases a continuous manufacturing method is used, to provide tubes of unlimited length. An engineering model with composite tubes was built and tested with satisfactory results. A qualification model with metal or composite tubes is proposed. Applications include satellite antenna and solar array deployment. ESA

N88-21197# I.A.M. Rinaldo Piaggio, Finale Ligure (Italy).
DEPLOYABLE/RETRIEVABLE BOOM: ONE APPLICATION TO TETHERED SATELLITE
P. Becchi and D. Miranda *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 37-46 (For primary document see N88-21191 14-18)
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The development, design, and qualification of a telescopic tubular deployable/retrievable boom rated to shuttle requirements for the tethered satellite mission are reviewed. The mechanism includes jettisoning provision and deployable harness for the supported payloads connection. Applications to other payloads and comparisons with other designs are discussed. ESA

N88-21198# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische.
DEPLOYABLE BOOMS AND ANTENNAS ON AMPTE-IRM
J. E. Stoecker and P. Parigger *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 47-50 (For primary document see N88-21191 14-18)
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Two instruments of the AMPTE ion release module satellite were deployed radially by rigid booms with two and one articulated sections respectively, which had to be balanced in the stowed and deployed configuration. Made from carbon and glass fiber, they deflected after deployment and protected the instruments against the locking shock. All boom mechanisms were made from nonmagnetic material. Tests were performed to qualify the booms. Two S-band radiators on top of 1.4 m solid booms were pivoted to the satellite skirt. Both could be oriented either parallel to the spin axis or, after deployment, perpendicular to it. A third S-band radiator was extended axially from the satellite aft end. The extension system was a modified commercial automobile antenna drive. The release mechanism of the 16 canisters which were ejected from the satellite to produce barium and lithium-plasma clouds is described. ESA

N88-21199# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PAYLOAD DEPLOYMENT SYSTEM **c16**
J. A. Remus and J. P. Birkedal *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 53-58 (For primary document see N88-21191 14-18)
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The Payload Deployment System (PDS), a payload separation system, was designed for the space shuttle orbiter. It is a guided, spring-driven system capable of deploying a payload that is both extremely heavy (i.e., 29,000 kg) and extremely large (i.e., full cargo bay volume with fore and aft clearance less than 25 cm). A separation analysis using a Monte Carlo random case technique determined that even under worst-case conditions, all separation requirements are met. A separation test was developed to verify this analysis. Extensive mechanism testing verifies PDS performance and safety requirements. ESA

N88-21200# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
NUMERICAL SOLUTION OF MULTIBODY SYSTEMS IN SPACE APPLICATIONS
B. Specht *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 59-63 (For primary document see N88-21191 14-18)
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A numerical analysis tool for 3D mechanical multibody systems is presented. The method is based on Lagrange's equation with constraints which are enforced by the Lagrange multiplier technique. Kinematic, static, and dynamic analysis modes are available. The in orbit deployment of a large parabolic antenna reflector was simulated. The CPU times for kinematic, quasi-static, and dynamic modes are 7.2, 21, and 32 min respectively on a VAX-750. ESA

N88-21201# Fokker B.V., Amsterdam (Netherlands).
THE DEVELOPMENT STATUS OF THE STRONGBACK ARRAY
R. Zwanenburg *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 65-71 (For primary document see N88-21191 14-18)
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A lifesize model of the strongback array (STAR) was built. The model demonstrates the feasibility of this deployable and retractable support structure. Deployment analyses show good correspondence with the test results. The measured bending stiffness of the mast in deployed condition is between 50,000 to 200,000 Nmsq. Stiffness depends on the preload condition and the considered load environment. Mast stiffness may decrease significantly if the mast shape deviates from the ideal deployed condition. A very simple mast layout without a bottom sliding rail is possible for deployments of experiment payloads. ESA

N88-21202# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
A SEQUENTIALLY DEPLOYABLE STRUCTURE FOR SPACE APPLICATIONS
F. Panin, M. Eiden, M. Sierra, and J. Rivacoba (Sener S.A., Las Arenas, Spain) *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 73-82 (For primary document see N88-21191 14-18)
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A large truss structure which deploys sequentially from the spacecraft was designed, and the deployment was simulated using the Automatic Dynamic Analysis of Mechanical Systems package. The development model of the deployable truss is formed by three bays. When in the deployed configuration, each bay is a cube of 1 m side formed of 2 battens connected by struts. By the use of joints in the middle and at the end of struts, the bay can be folded to a very reduced length. Actuation is achieved by torsional springs in the joints and the deployment is controlled according to a chosen law by the release of retaining cables. ESA

N88-21203# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div.
AEROSPATIALE UNFURLABLE REFLECTOR AND ASSOCIATED MECHANISMS
Y. Broustet, G. Brazzini, and E. Joseph-Gabriel *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 83-89 (For primary document see N88-21191 14-18)
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An unfurlable antenna concept, particularly the spring actuated hinge used in truss motorization, is presented. A 9 m reflector consisting of 24 prismatic truss sections with articulated connecting bars and a similar 4 m design are described. Torque characteristics of the hinge are discussed. ESA

N88-21204# Spar Aerospace Ltd., Weston (Ontario). Canadian Space Station Program.
SYSTEM AND CONCEPT DESIGN OF THE SSRMS LATCHING END EFFECTOR **c37**
E. Quittner, R. Vandersluis, J. Rakhsha, and I. Farmer *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 93-103 (For primary document see N88-21191 14-18)
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The latching end effector of the relocatable Space Station Remote Manipulator System (SSRMS) for the Mobile Servicing Center contribution to the Space Station is presented. The latching end effector, when installed on the two ends (shoulder and wrist) of the symmetrical manipulator arm provides the capability to interchange wrist and shoulder of the arm thus enabling manipulator relocatability. The latching end effector combines the snare and rigidize features of the existing Shuttle RMS end effector, with latching and umbilical electrical power and signal transfer features. Modified, existing, and new components are combined in an assembly of modular, orbit replaceable units. The existing components are enhanced by adding redundancy and orbit-maintainability provisions. Associated with the above is the power and data grapple fixture. The functions associated with the existing snare/rigidize and the new latching and umbilical elements can be executed independently. The SRMS based end effector and the SSRMS based functions can, therefore, be performed with the existing and the modified grapple fixtures as an interface. ESA

N88-21205# Sener S.A., Madrid (Spain).
LATCHING MECHANISMS FOR IOC **c37**
F. delCampo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 105-112 (For primary document see N88-21191 14-18)
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Two different latch mechanisms were designed for the IOC experiment in EURECA, to help the antenna pointing mechanism (APM) withstand the flight loads and to increase its first natural eigenfrequency. In both cases, the main objective is to obtain a high stiffness, paying special attention to the structural discontinuities (clamp, hinges, etc.), in order to eliminate the

backlash. This is obtained mainly by preloading these discontinuities and by selecting adequate materials to avoid problems of differential CTE that could change the preload in critical areas. The first latching system consists of two overcenter latches driven by a stepper motor through a worm gear reducer. Each of them locks one of the two degrees of freedom of the APM during launch and reentry. The second system has three pyrotechnically released mechanisms which fix the APM during launch. ESA

N88-21206# Contraves Italiana, Rome.
DARM: A NEW DEPLOYMENT AND RETRACTION MECHANISM WHICH DOES NOT NEED ELECTRIC POWER c37
D. Stella, M. Simonelli, and C. Piredda *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 113-123 Sponsored by CNR (For primary document see N88-21191 14-18)
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A self actuated joint to impart a direct or inverse circular planar trajectory to a spacecraft payload (1 to 10 kg) without any electric motion actuators was designed. The continuous motion of the discharge spring is converted to the motion of a swivel device by a modified Fairbairn guide. Modularity is achieved by dividing the mechanism into a master group containing the main structural elements and motion actuator, and a slave group with the end stop and locking devices. Dynamic, kinematic, and structural analysis, and functional and environmental testing confirm the feasibility of the concept. ESA

N88-21207# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
DEPLOYMENT, HOLD DOWN AND RELEASE MECHANISMS FOR WIND SCATTEROMETER ANTENNA (WSA) c37
A. Nunez, J. G. SanMartin, and P. Luengo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 125-134 (For primary document see N88-21191 14-18)
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The requirements, development, design and tests carried out for the mechanisms of the ERS-1 wind scatterometer antenna (WSA) are described. The devices are required for hold stowed, release, deploy, and latch of 2 of 3 arrays 3.6 m long that form the WSA, from the launch configuration to the operational configuration in orbit. The system consists of modular hinge, latch, monitoring and drive mechanisms for the deployment mechanism, and three levels of semi-isostatic mounts pyrotechnically liberated for the hold down and release mechanism. Tests on structural and engineering models are satisfactory. ESA

N88-21208# European Space Tribology Lab., Risley (England). Northern Research Labs.
MODELS FOR STEADY AND NONSTEADY COULOMB TORQUE IN BALL BEARINGS c37
M. J. Todd *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 137-148 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)
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For steady state torque estimation in ball bearings (equilibrium rolling and spinning of the ball), two alternative models are assessed against experimental data from typical space mechanism bearings. The calculation of steady torque requires a measured value of sliding friction coefficient between ball and race. In small-angle oscillations, where the rolling/spinning motion of the ball does not reach an equilibrium value, the torque describes hysteresis loops whose size and shape depend upon the amplitude of oscillation. A method of loop estimation based upon the Dahl fit and with a quantitative estimate of the initial stiffness, i.e., the torque per unit angle is discussed. Predictions are compared with experiment. It is concluded that in a bearing with many balls or with thin-section, easily distortable rings, it is necessary to allow for nonuniform loading at the points of contact. ESA

N88-21209# European Space Tribology Lab., Risley (England). Northern Research Labs.
THE PERFORMANCE OF THIN SOLID FILMS FOR SATELLITE GEARS c27
R. A. Rowntree and M. K. Vine *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 149-154 (For primary document see N88-21191 14-18)
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The use of thin solid films on spur gears for satellite mechanisms was investigated. To reduce gear wear, the use of physical vapor deposited films of TiN was examined. To improve overall gear efficiency, the performance of solid lubricating films of ion-plated lead and magnetron-sputtered MoS2 were evaluated. On steel gear substrates, commercial TiN films are found to give short lives because of poor adhesion to the tooth flanks. For maximum lubricant film life, the optimum thickness of the as-deposited lead is found to be 1 micron. Testing indicates that magnetron-sputtered MoS2 films give a shorter life on steel gears than ion-plated lead. ESA

N88-21210# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
BALL BEARINGS WITH CHEMICAL VAPOR DEPOSITION (CVD)-TiC COATED COMPONENTS c37
H. Boving, H. E. Hintermann, and W. Haenni *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 155-159 (For primary document see N88-21191 14-18)
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Metallurgical and geometrical aspects of high precision TiC coated AISI 440C steel balls are presented. The chemical vapor deposition process used to produce the coating provides a good metallurgical bond with the substrate and hence a good adherence. Due to its elevated hardness and its fine-grained microstructure, the TiC coating can be polished to produce high precision balls with specifications better than those corresponding to Grade 3 AFBMA. The TiC has favorable friction properties with respect to steel. These advantages of TiC-coated balls make their use in ball bearings attractive. The TiC-coated balls can increase the performance of oil/grease-lubricated, and oil/grease-free bearings in a wide variety of environments, ranging from normal air to space conditions, at temperatures commonly encountered in aerospace applications. ESA

N88-21211# Societe Nationale Industrielle Aerospatiale, Cannes (France).
THE SPOT SOLAR ARRAY. BOX OPENING MECHANISMS PHYSICAL VAPOR DEPOSITION (PVD)-MoS2: LUBRICATED SLIDES. FUNCTIONAL EVALUATION c37
J. F. Patin, J. L. Cecconi, L. Decramer, and E. Conde (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 161-166 (For primary document see N88-21191 14-18)
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To estimate in-flight safety margins and to delineate the parameters which influence the friction coefficient, the MoS2 lubrication of the opening mechanism for the stowage box of the SPOT solar array, a set of steel slides restrained by aluminum alloy jumpers, was investigated. Effects of moisture, vacuum, and repeated operations on friction were studied. Measurements on the stowage box slides show low initial dispersions of the friction characteristics; mean reduction of friction effects by 60 percent to be considered for box opening in orbit with respect to the friction values measured in ground tests at 70 percent moisture; and 10 openings as the desirable number of prelaunch operations, with the frictional characteristics thus stabilized still preserved after 24 openings at least. ESA

N88-21212# RCA Aerospace and Defense, Princeton, N.J. Astro-Space Div.
DEVELOPMENT OF AN INTERMODULE CONNECTOR FOR SERVICEABLE SPACECRAFT
A. P. Matthews, S. W. Jackson, D. W. Gross, and O. L. Regalado *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 169-176 (For primary document see N88-21191 14-18)
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An Intermodular Connector (IMC) that can be applied universally to all types of spacecraft modules to optimize the remote mating of platform modules was developed. The operating principle is based on gross alignment to put the screw in contact with the floating nut. Once the face plates are together, the screw continues to rotate, drawing the connector plate down. The IMC uses an acme threaded screw mechanism for closure, rigidization, and connector-mating functions. This mechanism, centrally located on a triangular plate, was manufactured in three parts: the motor and gears, the acme threaded screw, and the floating nut. Mechanical models for proof of concept testing were built. ESA

N88-21213# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
AN ADVANCED LOW-COST 2-AXIS ACTIVE MAGNETIC BEARING FLYWHEEL c37
M. Gauthier, J. P. Roland, H. Vaillant, and A. A. Robinson (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 177-182 (For primary document see N88-21191 14-18)
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A magnetic bearing reaction wheel is described. It features a compact and very stiff magnetic bearing of the two axis active type, a brushless dc drive motor with very low ripple torque, fully redundant built-in electronics for the suspension and drive functions, and a simple locking mechanism for securing the inertial rotor member during launch. The construction features of the unit are discussed and its overall characteristics and performances are given. The latter compare favorably with those of ball bearing wheels with the same momentum capacity. ESA

N88-21214# Societe Anonyme d'Etudes et Realisations Nucleaires, Limeil-Brevannes (France).
HIGH LIFETIME MECHANISMS IMPLEMENTED IN INFRARED HORIZON SCANNING SENSORS c37
M. Pochard and G. Wallis *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 183-189 (For primary document see N88-21191 14-18)
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The design, development, life tests, and inflight performance of the scanning mechanism of the SPOT infrared Earth sensor are presented. The lubrication of ball bearings and gears as well as vibration problems encountered are analyzed. Design rules and life time modeling are discussed. Ball bearing life tests results are presented. Developments in infrared sensor mechanisms are outlined. ESA

N88-21215# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
RF-SWITCHES: APPLICATION AND DESIGN c33
W. Auer, E. Hettlage, and G. Ruff *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 191-195 (For primary document see N88-21191 14-18)
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Transponders for communication satellites which utilize flexible switching and redundancy schemes are introduced. For instance, in a 10 channel transponder arrangement, 3 cold redundant channels can be assigned, where up to 3 of the 10 primary transponders can fail arbitrarily without an impact on the satellite's communication capacity. To accomplish this task, electro-Mechanically actuated RF-switches are placed at the input and output of each transponder with interconnections between these switches. High reliability and long life are mandatory. The demanding RF-requirements call for maximum insertion losses of 0.05 dB, isolation values of up to 60 dB, reflection properties less than or equal to 1.08:1 and power ratings of the order of 100 W for frequency bands centering around 12 GHz, and 30 GHz. Lightweight but rigid high precision designs must be developed to cope with the extreme mechanical stresses introduced by waveguide networks. ESA

N88-21216# Milan Univ. (Italy).
MECHANICAL DESIGN OF A ULTRAHIGH GRAVITY UHV FACILITY TO LAUNCH AND RECOVER A LOW-SPEED PROJECTILE TESTED ON BOARD KC 135 c14
G. Poletti and D. Cambiaghi (Centrotecnica, Milan, Italy) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 197-203 Sponsored by Piano Spaziale Nazionale-CNR (For primary document see N88-21191 14-18)
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To perform an experiment on surface forces in metals a facility was designed, manufactured and tested on the ground and in microgravity in preparation for a EURECA experiment, on surface forces and adhesion in contacting solids. The facility must launch a small projectile against a plane target at very low velocity. After rebounding the projectile must be recovered and launched again several times at different velocities. The motion of the projectile is a pure translation and the experiment is performed under ultrahigh vacuum. The mechanical design of the facility is discussed together with the results of the tests performed in the laboratory and on board a KC135 in microgravity conditions. The facility meets requirements. ESA

N88-21217# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DESIGN OF A LINEAR ACTUATOR AND BREADBOARD TEST RESULT c37
R. G. Hostenkamp *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 207-210 (For primary document see N88-21191 14-18)
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For the set of 15 mechanisms required to control the end positions of the deployable antenna petals of the Far Infrared and Submillimeter Space Telescope, a linear actuator capable of generating submicron steps was designed. The microsteps of a stepper motor are transferred by a spindle to a lever which deflects a slotted circular spring. The resulting diametral change of the spring represents the output stroke of the actuator. By a thermally stable design utilizing conventional material, the actuator is suited for an operational temperature range from 80 C to cryogenic conditions. The design of the linear actuator is described and test results from a breadboard model are reported. ESA

N88-21218# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PHOTOELASTIC MODEL TESTS OF THE DORNIER LINEAR ACTUATOR c37
P. Coste *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 211-221 (For primary document see N88-21191 14-18)
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A linear actuator was designed for fine adjustment of the Far Infrared and Submillimeter Space Telescope antenna to achieve very small displacements with demanding requirements. Its core element is a slotted circular spring deflected by means of two levers, with two integral leaf springs forming a flexible pivot. Breadboard performance is very satisfactory, but the leaf springs are critically stressed in bending. Analyses used a simple classical strength of materials model as first approximation, then a photoelastic model also used as hardware reference; a fine finite element model allowed comparisons and checks. Analytic results

are in reasonable agreement with experiment. Design modifications of the breadboard model are required to reduce excessive stresses. ESA

N88-21219# Sener S.A., Madrid (Spain).
FINE ADJUSTMENT MECHANISM FOR FIRST **c37**
F. delCampo, J. delTorro, and J. Rivacoba *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 223-227 (For primary document see N88-21191 14-18)
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An actuator mechanism to fulfill the very tight requirements of the adjustment mechanism for the Far Infrared and Submillimeter Space Telescope (FIRST) Antenna was designed. The main requirement for such mechanism was to achieve very small angular increments of a panel with respect to its hinge without backlash, while having a high stiffness. A functional model of this mechanism was tested to demonstrate the feasibility of the concept. A further development is required to improve the design in aspects like sensitivity to temperature changes expected in FIRST operation. ESA

N88-21220# University Coll., London (England). Mullard Space Science Lab.
DEVELOPMENT OF A CRYOGENIC STEPPING DRIVE FOR ISO/LWS **c37**
T. J. Patrick and R. C. Sidey (Sidey, R. C., Richmond, England) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 229-232 (For primary document see N88-21191 14-18)
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Results of torque and running tests at 4K of the stepmotor and geared drive of the Infrared Space Observatory long wavelength spectrometer (ISO/LWS) are given. Torque and power were measured with a second prototype 2 phase motor scaled down to 130 grams. Specially developed torquemeter and other instrumentation indicate motor torque up to 0.02 Nm for a few mA, and an energy consumption of 0.4 J for the required operation, which is the interchange of Fabry-Perot interferometers within a few seconds. Position control, thermal contraction, strength and operational life of ISO/LWS are discussed. ESA

N88-21221# Societe Nationale Industrielle Aerospatiale, Cannes (France).
CRYOGENIC MECHANISM FOR ISO CAMERA **c35**
G. Luciano *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 233-236 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

The Infrared Space Observatory (ISO) camera configuration, architecture, materials, tribology, motorization, and development status are outlined. The operating temperature is 2 to 3 K, at 2.5 to 18 microns. Selected material is a titanium alloy, with MoS2/TiC lubrication. A stepping motor drives the ball-bearing mounted wheels to which the optical elements are fixed. Model test results are satisfactory, and also confirm the validity of the test facilities, particularly for vibration tests at 4K. ESA

N88-21222# Centre National d'Etudes Spatiales, Toulouse (France).
ROBOTIC JOINT PROTOTYPE FOR SPACE APPLICATIONS **c37**
A. Borrien and L. Petitjean *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 237-244 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

Ultravacuum test results of a robotic joint with high Hertzian pressure on the teeth are presented. Endurance tests prove good component behavior after 3 months under vacuum and after 121 hr working time, except for the brake which has problems due to temperature increase. The feasibility of a 150 mm diameter and 100 mm length robotic joint, allowing 10 mN dynamic output torque and 60 mN static torque is shown for more than 100 hr lifetime with dry lubrication. The backlash and friction torque stability reveal a potential lifetime increase without significant damage. The feedback law must be improved to take into account high frequency resonance problems, inertia simulator stiffness effects, and backlash consequences. ESA

N88-21223# University Coll. of North Wales, Bangor.
TOWARDS A PRACTICAL MICROGRAVITY ENVIRONMENT **c29**
A. R. Owens and D. I. Jones *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 245-250 (For primary document see N88-21191 14-18)
(Contract ESTEC-1755/85-Rider-1)
Copyright Avail: NTIS HC A14/MF A01

The specification for a microgravity isolation mount (MGIM) is defined in terms of transmissibility of motion between a frame attached to the body of the spacecraft and a semi-free-floating platform upon which experiments are mounted. Six-degree-of-freedom (DOF) noncontact actuators and position sensors, data transmission, and power supply are described. They were demonstrated on a three-DOF breadboard model. Experimental measurements of transmissibility confirm the validity of the proposed control strategy, and agree with the performance predicted by computer modeling. Performance predictions with a six-DOF model show that a system of uncoupled control loops provides adequate control. A design of an MGIM module for deployment in future space flights is proposed. ESA

N88-21224# European Space Tribology Lab., Risley (England). Northern Research Labs.
A TEST FACILITY FOR THE IN-VACUO ASSESSMENT OF DRY LUBRICANTS AND SMALL MECHANISMS AT CRYOGENIC TEMPERATURES **c14**
E. W. Roberts, S. G. Gould, J. A. Duvall, and P. McDonald (Southampton Univ., England) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 253-259 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

A vacuum, cryogenic test facility was employed to test ball bearings lubricated with different types of dry lubricant. Initial measurements on the efficacy of the lubricants at a temperature of 20K are reported. The use of the facility to test gears and small mechanisms, and to measure thermal conductance across load-determined contact areas, at cyrogenic temperatures is also discussed. Frictional torque increases with decreasing temperature due to increases of lubricant shear strength. ESA

N88-21225# Sener S.A., Madrid (Spain).
THE EURECA ANTENNA DEPLOYMENT AND RETRACTION MECHANISMS **c37**
M. Fuentes, C. Pascual, and R. Bureo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 261-266 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

The design of the Antenna Deployment and Retraction Mechanisms (ADRM) and the qualification test are described. The ADRM consists of a 2 m CFRP boom which is hinged at the S/C mounting interface and latched against the S/C structure at the other end, where the S-band antenna is attached. The hinge is actuated by a dc motor with gear box incorporated, and an external worm gear. The latch that holds the ADRM boom for launch and reentry is an overcentered four bar latch, prestressed by a torsion bar, and opened and closed by a motor identical to the one used in the hinge. Status of ADRM operation phases is monitored by microswitches. ESA

N88-21226# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
QUALIFICATION OF THE OLYMPUS REACTION WHEEL **c37**

G. J. Sturtivant *In* ESA, Proceedings of the 3rd European Space Mechanisms and Symposium Dec. 1987 p 267-272 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

Functional (torque) vibration, thermal vacuum, and life tests on the OLYMPUS satellite 10 Nms reaction wheel are summarized. Test equipment and procedures are described. Results are satisfactory. ESA

N88-21227# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
DEVELOPMENT AND QUALIFICATION OF THE OLYMPUS ANTENNA POINTING MECHANISM c37
P. J. Lovett *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 273-280 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

The OLYMPUS antenna pointing mechanism (APM), a modular mechanical unit which interfaces between antenna reflectors and the spacecraft structure and which is capable of reorientating the reflectors with respect to the spacecraft, is presented. The APM can support reflectors in the launch phase and in the on-station mode. Reorientation of the reflectors is carried out in open loop mode where the APM is repointed upon command from the ground, and in closed loop mode where the APM is required to respond on a continuous basis to RF error signals. In both modes the APMs are controlled by the APM electronics (APME) which generates the required stepping demands for the APM. On OLYMPUS five such APM are controlled by one electronics unit, the APME. These equipments form the antenna pointing subsystem. Four of the mechanisms operate in open loop mode and the fifth can operate both in on and off boresight of a radio frequency beacon. Test results and design modifications are summarized. ESA

N88-21228# Societe Nationale Industrielle Aerospatiale, Cannes (France). Cryogenic Lab.
CRYOGENIC TEST FACILITIES FOR AN OPTICAL CRYOMECHANISM QUALIFICATION c14
S. Taride *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 281-284 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

Test programs for cryogenic spacecraft mechanisms are discussed. A gaseous thermal cycling 4 to 300 K cryostat, cold shaking test facilities, and a helium cryostat are described. ESA

N88-21229# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
QUALIFICATION TESTING OF THE EUROSTAR SOLAR ARRAY DRIVE MECHANISM (SADM) c37
I. D. Henderson *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 285-294 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

The EUROSTAR satellite communication platform solar array drive power ring unit; baseplate shaft and main bearing assembly; motor and gearbox assembly; signal slip-ring unit; and datum sensors are described. Subassembly; nonoperational; functional; vibration; thermal vacuum; and accelerated life tests are summarized. ESA

N88-21230# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
EVOLUTION OF LARGE MOMENTUM AND REACTION WHEELS c37
H. Heimel *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 297-302 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

Momentum and reaction wheels with diameters of 45 and 60 cm producing angular momentum ceilings of 300 and 1000 Nms are presented. For the 1000 Nms wheel, an engineering model is being built and tested. Design and expected performance data are given. A modular family of flywheels with momentums between 1 and 1000 Nms is also presented. ESA

N88-21231# European Space Tribology Lab., Risley (England).
SEPARABLE ELECTRICAL CONNECTORS FOR SPACE: A TRIBOLOGICAL AND ELECTRICAL ASSESSMENT c33
E. W. Roberts, J. D. Porteous, and N. Cable (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 303-309 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

The electrical and tribological properties of separable electrical connectors were examined in air and vacuum. Two types of commercially available connector were tested, each of which utilized gold-plated pins and sockets. Contact resistances of each pin/socket connection remain essentially constant throughout testing and is the same in vacuum and air. However, insertion and extraction forces in vacuum are significantly higher than the corresponding forces in air at atmospheric pressure. Examination of pins following accelerated life testing shows wear attributable to the plowing action of socket retainer springs. Nevertheless, wear over 500 insertion/extraction cycles is acceptably low. Connectors subjected to fretting tests (over 1 million cycles) show no electrical degradation and no discernible contact wear. Studies aimed at determining whether there exists a need to screen pins and sockets for space connectors are mentioned. ESA

N88-21232# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
A JOINT ACTUATOR DESIGN FOR A ROBOTIC MANIPULATOR c37
K. Priesett *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 311-316 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

A rotary actuator design for space robotic manipulator applications was established. Major characteristics are high torque capability, high stiffness, very low backlash, backdriveability, and high resolution position measurement. The unit is very compact and includes a cyclo drive as the major gear system. However, due to the modular concept, a different gear system could be implemented with only minor changes in the gearbox module. The results of the main trade-offs performed on the gear system are summarized. ESA

N88-21233# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
DOCKING/BERTHING SUBSYSTEM: DESIGN AND BREADBOARD TEST
N. Cable and J. Hartmann (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 317-326 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

Based on a low impact docking concept and a latching mechanism concept, a docking/berthing subsystem and its operations were defined. A set of four breadboard models of the latch were manufactured and locking tests were performed on a four degree of freedom air bearing table. The tests demonstrate feasibility of the low impact docking concept under the test facility conditions. ESA

N88-21234# Sener S.A., Madrid (Spain).
OLYMPUS SHUTTLE SPECIFIC RADIATOR SHIELD c16
C. Pascual and F. Artigas *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 327-332 (For primary document see N88-21191

14-18)
Copyright Avail: NTIS HC A14/MF A01

The Shuttle Specific Radiator Shield (SSRS) subsystem to provide thermal protection for the radiators and solar arrays of L-SAT during the early phase of its mission is described. The SSRS subsystem is made up of two radiator shield assemblies (RSA). Each RSA is an aluminum alloy riveted structure covered by a Kapton blanket to maintain the thermal conditions. The item is fixed to the spacecraft structure by means of deployment and ejection mechanisms and a separation nut on the top. Tests of the RSA qualification model prove capability to fulfill the specified requirements. ESA

N88-21235# National Bureau of Standards, Boulder, Colo. Time and Frequency Div.
NBS (NATIONAL BUREAU OF STANDARDS) MEASUREMENT SERVICES. GOES (GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE) TIME CODE DISSEMINATION: DESCRIPTION AND OPERATION Final Report
R. E. Beehler, D. Davis, and J. B. Milton Jan. 1988 52 p
(PB88-168760; NBS/SP-250/30; LC-87-619906) Avail: HC A04/MF A01; also available SOD HC $2.75 as SN003-003-2845-2 CSCL 22B

The Geostationary Operational Environmental Satellite (GOES) satellite time code dissemination system operated by the NBS to provide time and frequency users with an NBS traceable reference signal for calibration and general timekeeping applications is described. The discussion includes the various subsystems to generate, monitor, and verify the timing signals located at NBS/Boulder, NOAA/Wallops Island, Va, NBS/Fort Collins, Colo., and several other dispersed sites. Some of the main operational procedures used in providing a close approximation to UTC(NBS) at any user's location in the Western Hemisphere are described, along with an anlaysis of the uncertainties associated with the GOES time code generation, transmission through the satellite path, and reception at the user's site. Techniques and facilities used to maintain internal quality control are also described. GRA

N88-21236# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
SATELLITE ACQUISITION: GLOBAL POSITIONING SYSTEM ACQUISITION CHANGES AFTER CHALLENGER'S ACCIDENT
Sep. 1987 39 p
(PB88-155536; GAO/NSIAD-87-209BR) Avail: NTIS HC A03/MF A01 CSCL 22B

The NAVSTAR Global Positioning System (GPS) is reviewed to determine how the Air Force modified its acquisition approach for the system following the space shuttle Challenger accident. GRA

N88-21237# Pacific Northwest Labs., Richland, Wash.
FABRIC SPACE RADIATORS
Z. I. Antoniak, W. J. Krotiuk, B. J. Webb, J. T. Prater, and J. M. Bates Jan. 1988 79 p
(Contract DE-AC06-76RL-01830)
(DE88-005569; PNL-6458) Avail: NTIS HC A05/MF A01

Future Air Force space missions will require thermal radiators that both survive in the hostile space environment and stow away for minimal bulk during launch. Advances in all aspects of radiator design, construction, and analysis will be necessary to enable such future missions. Currently, the best means for obtaining high strength along with flexibility is through structures known as fabrics. The development of new materials and bonding techniques has extended the application range of fabrics into areas traditionally dominated by monolithic and/or metallic structures. Given that even current spacecraft heat rejection considerations tend to dominate spacecraft design and mass, the larger and more complex designs of the future face daunting challenges in thermal control. Ceramic fabrics bonded to ultra-thin metal liners (foils) have the potential of achieving radiator performance levels heretofore unattainable, and of readily matching the advances made in other branches of spacecraft design. The research effort documented here indicates that both pumped loops and heat pipes constructed in ceramic fabrics stand to benefit in multiple ways. Flexibility and low mass are the main advantages exhibited by fabric radiators over conventional metal ones. We feel that fabric radiators have intrinsic merits not possessed by any other radiator design and need to be researched further. Author

N88-21238# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOLAR CELL EXPERIMENT ON THE FIRST SATELLITE OF THE BRAZILIAN COMPLETE SPACE MISSION
Paulo Nubile, Nelson Veissid, Antonio F. Beloto, Leonel F. Perondi, and Afranio TorresFilho Jul. 1987 10 p Presented at the 8th Brazilian Congress of Vacuum Application in Industry and Science (CBRAVIC), Rio de Janeiro, RJ, 22-24 Jul. 1987
(INPE-4248-PRE/1121) Avail: NTIS HC A02/MF A01

The first data collection satellite of the Brazilian Complete Space Mission (MECB), whose launching is anticipated for the first half of 1989, carries on board the Solar Cell Experiment (SCE) which is intended to demonstrate the capacity of the National Research Laboratory in the production of space quality solar cells and solar panels. The SCE consists of the use of a 61 x 61 millimeter area, available on one of 8 lateral panels on the satellite in an arrangement of three arrays of two 20 x 19 millimeter solar cells in series, a total of six solar cells. Each array is connected to a fixed charge resistor, forcing the operation of the cells at the point of open circuit, short-circuit, and maximum potential, which permits the observation of the degradation of the parameters of interest (V sub OC, I sub SC, I sub mp, and V sub mp) with the thermal cycles and radiation damage during the mission. Author

N88-21239*# National Aeronautics and Space Administration, Washington, D.C.
COMPARISON OF METHODS FOR THE CALCULATION OF THERMAL CONTACT RESISTANCE OF THE FIRST BRAZILIAN SATELLITE M.S. Thesis - Instituto de Pesquisas Espaciais, 6 Dec. 1985
Marcia B. H. Mantelli Apr. 1988 101 p Transl. into ENGLISH of Brazilian Thesis p 1-105 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20180; NAS 1.77:20180; INPE-3864-TDL/217) Avail: NTIS HC A06/MF A01 CSCL 22B

A comparative study of the methods developed for the calculation of thermal contact resistance between two surfaces submitted to a perpendicular heat flux is presented. Several factors affecting this resistance are analyzed and a brief historical review of the works in this field is made, spotting the methods of interest for space applications. These are compared to experimental data so as to establish the most proper method for the couplings of the first Brazilian satellite. Author

N88-21240# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A FEEDBACK DOUBLE PATH COMPENSATING CONTROL STRUCTURE FOR THE ATTITUDE CONTROL OF A FLEXIBLE SPACECRAFT
Decio Castilho Ceballos Feb. 1988 8 p Presented at the 5th IFAC/IFIP Symposium on Software for Computer Control, South Africa, 26-28 Apr. 1988
(INPE-4464-PRE/1239) Avail: NTIS HC A02/MF A01

A Feedback Double Path Compensating (FDPC) control structure is considered for the attitude control of a flexible spacecraft, where vibration modes and modeling errors are present. Parameter optimization is applied for finding the controller so as to have optimized behavior for a high-order model. The fourth-order FDPC controller was tested for the one-axis attitude control of a spacecraft with flexible appendages, whose dynamics were approximated by a fourteenth-order linear invariant model. The FDPC controller was compared with a low-order controller and is shown to be less sensitive to modeling errors. Author

N88-21241*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
IN-FLIGHT RAIN DAMAGE TESTS OF THE SHUTTLE THERMAL PROTECTION SYSTEM
Robert R. Meyer, Jr. and Jack Barneburg (National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.) May 1988 16 p Presented at the 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100438; H-1484; NAS 1.15:100438; AIAA-88-2137) Avail: NTIS HC A03/MF A01 CSCL 22B

NASA conducted in-flight rain damage tests of the Shuttle thermal protection system (TPS). Most of the tests were conducted on an F-104 aircraft at the Dryden Flight Research Facility of NASA's Ames Research Center, although some tests were conducted by NOAA on a WP-3D aircraft off the eastern coast of southern Florida. The TPS components tested included LI900 and LI2200 tiles, advanced flexible reusable surface insulation, reinforced carbon-carbon, and an advanced tufi tile. The objective of the test was to define the damage threshold of various thermal protection materials during flight through rain. The test hardware, test technique, and results from both F-104 and WP-3D aircraft are described. Results have shown that damage can occur to the Shuttle TPS during flight in rain. Author

N88-21242*# California Univ., Davis. Dept. of Psychology.
INCORPORATION OF PRIVACY ELEMENTS IN SPACE STATION DESIGN Final Report, 1 Jan. - 31 Dec. 1987
Albert A. Harrison, Barrett Caldwell, and Nancy J. Struthers 20 May 1988 60 p
(Grant NAG2-431)
(NASA-CR-182748; NAS 1.26:182748) Avail: NTIS HC A04/MF A01 CSCL 22B

Privacy exists to the extent that individuals can control the degree of social contact that they have with one another. The opportunity to withdraw from other people serves a number of important psychological and social functions, and is in the interests of safety, high performance, and high quality of human life. Privacy requirements for Space Station crew members are reviewed, and architectual and other guidelines for helping astronauts achieve desired levels of privacy are suggested. In turn, four dimensions of privacy are discussed: the separation of activities by areas within the Space Station, controlling the extent to which astronauts have visual contact with one another, controlling the extent to which astronauts have auditory contact with one another, and odor control. Each section presents a statement of the problem, a review of general solutions, and specific recommendations. The report is concluded with a brief consideration of how selection, training, and other procedures can also help Space Station occupants achieve satisfactory levels of seclusion. Author

N88-21243*# Hughes Research Labs., Malibu, Calif.
SPACECRAFT DIELECTRIC SURFACE CHARGING PROPERTY DETERMINATION Final Report, Sep. 1980 - Nov. 1981
W. S. Williamson Oct. 1987 84 p
(Contract NAS3-22540)
(NASA-CR-180879; NAS 1.26:180879) Avail: NTIS HC A05/MF A01 CSCL 22B

The charging properties of 127 micron thick polyimide, (a commonly used spacecraft dielectric material) was measured under conditions of irradiation by a low-current-density electron beam with energy between 2 and 14 keV. The observed charging characteristics were consistent with predictions of the NASCAP computer model. The use of low electron current density results in a nonlinearity in the sample-potential versus beam-energy characteristic which is attributed to conduction leakage through the sample. Microdischarges were present at relatively low beam energies. Author

N88-21244*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AEROASSIST FLIGHT EXPERIMENT GUIDANCE QUIET TIME
Scott A. Striepe and William T. Suit Feb. 1988 78 p
(NASA-TM-100556; NAS 1.26:100556) Avail: NTIS HC A05/MF A01 CSCL 22B

The science experiments for the Aeroassist Flight Experiment (AFE) will be greatly enhanced by taking measurements with no Reaction Control System (RCS) contamination just before perigee. Methods of modifying the AFE guidance to accomplish this are discussed. Several methods that could give up to 30 seconds of quiet time were investigated and the results of these guidance modifications shown. A 20 second quiet time is definitely possible and a 30 second quiet time may be possible if the guidance can be inactive past perigee. Some of the most significant being the criterion for determining if the mission is threatened. A limited follow-on test program is outlined. Author

N88-21245*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE STATION POWER SYSTEM REQUIREMENTS
John W. Dunning, Jr. 1988 11 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ASC and AIChE
(NASA-TM-100886; E-4119; NAS 1.15:100886) Avail: NTIS HC A03/MF A01 CSCL 22B

Presented is an overview of the requirements on which the Space Station Electric Power System is based as well as a summary of the design itself. The current design, which is based on silicon photovoltaic arrays, NiH2 batteries, and 20 kHz distribution technology, meets all of the requirements. Author

N88-21131 Joint Publications Research Service, Arlington, Va.
PRC SPACE SATELLITE ACHIEVEMENTS HIGHLIGHTED
Chunting Zhang *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 1-5 Transl. into ENGLISH from Liaowang Overseas Edition (Hong Kong, People's Republic of China), no. 17, 27 Apr. 1987 p 14-15 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

N88-21473*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE X-BEAM AS A DEPLOYABLE BOOM FOR THE SPACE STATION
Louis R. Adams *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 59-66 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

N88-21479*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
A SPIN AND DEPLOYMENT MECHANISM
David W. Preston and Todd A. Girkins *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 149-161 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

N88-21491*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION FULL-SCALE DOCKING/BERTHING MECHANISMS DEVELOPMENT
Gene C. Burns, Harold A. Price, and David B. Buchanan *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 325-340 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

N88-21494*# Lockheed Space Operations Co., Cocoa Beach, Fla.
ORBITER PROCESSING FACILITY SERVICE PLATFORM FAILURE AND REDESIGN
Jesse L. Harris *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 373-386 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N88-21246*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ANALYSIS OF CONTAMINATION DATA RECORDED BY THE IECM CAMERA/PHOTOMETER

K. Stuart Clifton and Carl M. Benson Mar. 1988 55 p
(NASA-TM-100324; NAS 1.15:100324) Avail: NTIS HC A04/MF A01 CSCL 14B

The Camera/Photometer was one of the ten instruments comprising the Induced Environment Contamination Monitor (IECM) developed to monitor the contamination about the Space Shuttle Orbiter during early missions. This experiment consisted of two motion picture cameras, integrating photometers, and associated electronics enclosed in pressurized canisters and separated by 40 cm in order to make stereoscopic observation of particulates. The objectives of the experiment were to record the occurrence of particulates and to determine their velocities, sizes and origins, as well as to measure the background brightness due to unresolved particles. Particle tracks were detected on over 1800 data frames recorded during continuous operations throughout STS-2, -3, -4, and -9. This report discusses the analysis techniques employed in reducing subsequent results, with an emphasis placed on particle size and velocity data. It also describes the operation of the overall experiment and some of the results obtained. Author

N88-21247# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.

MAXIE 1 Progress Report, 1 Oct. - 31 Dec. 1987

William L. Imhof, Henry D. Voss, and Victor Chinn 17 Dec. 1987 6 p
(Contract N00014-87-C-0050)
(AD-A189688; LMSC/D068466) Avail: NTIS HC A02/MF A01 CSCL 03A

The satellite flight of the MAXIE-1 (Magnetospheric Atmospheric X-ray Imaging Experiment) instrument is being implemented under ONR (the Office of Naval Research) sponsorship. The MAXIE-1 instrument is being developed as a joint activity of Lockheed, the Aerospace Corporation, and the University of Bergen; much of the Lockheed development has been done under the Independent Research Program. Under ONR sponsorship that institution is responsible for managing the program, for providing spacecraft interface requirements, for providing interface activities undertaken in the last three months. Interactions have continued with co-investigators at the Aerospace Corp. and at the University of Bergen. NASTRAN model calculations, thermal analyses and an updated MAXIE assembly drawing and other drawings have been provided to RCA. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-21248# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

A COMPARISON OF PROPULSION SYSTEMS FOR POTENTIAL SPACE MISSION APPLICATIONS

E. A. Harvego and T. K. Sulmeisters 1987 6 p Presented at the ASME Winter Meeting, Boston, Mass., 13 Dec. 1987 Prepared in cooperation with Martin Marietta Corp., Englewood, Colo.
(Contract DE-AC07-76ID-01570)
(DE88-005637; EGG-M-38287; CONF-871234-12) Avail: NTIS HC A02/MF A01

A derivative of the NERVA nuclear rocket engine was compared with a chemical propulsion system and a nuclear electric propulsion system to assess the relative capabilities of the different propulsion system options for three potential space missions. The missions considered were: (1) orbital transfer from Low Earth Orbit (LEO) to Geosynchronous Earth Orbit (GEO), (2) LEO to a lunar base, and (3) LEO to Mars. The results of this comparison indicate that the direct-thrust NERVA-derivative nuclear rocket engine has the best performance characteristics for the missions considered. The combined high thrust and high specific impulse achievable with a direct-thrust nuclear stage permits short operating times (transfer times) comparable to chemical propulsion systems, but with considerably less required propellant. While nuclear-electric propulsion systems are more fuel efficient than either direct-nuclear or chemical propulsion, they are not stand-alone systems, since their relatively low thrust levels require the use of high-thrust ferry or lander stages in high gravity applications such as surface-to-orbit propulsion. The extremely long transfer times and inefficient trajectories associated with electric propulsion systems were also found to be a significant drawback. DOE

N88-21249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCED SENSIBLE HEAT SOLAR RECEIVER FOR SPACE POWER

Timothy J. Bennett (Sverdrup Technology, Inc., Cleveland, Ohio.) and Dovie E. Lacy 1988 12 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ASC and AIChE
(NASA-TM-100847; E-4008; NAS 1.15:100847) Avail: NTIS HC A03/MF A01 CSCL 10B

NASA Lewis, through in-house efforts, has begun a study to generate a conceptual design of a sensible heat solar receiver and to determine the feasibility of such a system for space power applications. The sensible heat solar receiver generated in this study uses pure lithium as the thermal storage medium and was designed for a 7 kWe Brayton (PCS) operating at 1100 K. The receiver consists of two stages interconnected via temperature sensing variable conductance sodium heat pipes. The lithium is contained within a niobium vessel and the outer shell of the receiver is constructed of third generation rigid, fibrous ceramic insulation material. Reradiation losses are controlled with niobium and aluminum shields. By nature of design, the sensible heat receiver generated in this study is comparable in both size and mass to a latent heat system of similar thermal capacitance. The heat receiver design and thermal analysis was conducted through the combined use of PATRAN, SINDA, TRASYS, and NASTRAN software packages. Author

N88-21250*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SPACE STATION SOLAR CONCENTRATOR MATERIALS RESEARCH

Daniel A. Gulino May 1988 15 p
(NASA-TM-100862; E-4074; NAS 1.15:100862) Avail: NTIS HC A03/MF A01 CSCL 10B

The Space Station will represent the first time that a solar dynamic power system will be used to generate electrical power in space. In a system such as this, sunlight is collected and focused by a solar concentrator onto the receiver of a heat engine which converts the energy into electricity. The concentrator must be capable of collecting and focusing as much of the incident sunlight as possible, and it must also withstand the atomic oxygen bombardment which occurs in low Earth orbit (LEO). This has led to the development of a system of thin film coatings applied to the concentrator facet surface in a chamber designed especially for this purpose. The system of thin film coatings employed gives both the necessary degree of reflectance and the required protection from the LEO atomic oxygen environment. Author

N88-21251*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER TRANSMISSION STUDIES FOR TETHERED SP-100
David J. Bents 1988 16 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ASC and AIChE
(NASA-TM-100864; E-4081; NAS 1.15:100864) Avail: NTIS HC A03/MF A01 CSCL 10B

The tether and/or transmission line connecting the SP-100 to space station presents some unorthodox challenges in high voltage engineering, power transmission, and distribution. The line, which doubles as a structural element of this unusual spacecraft, will convey HVDC from SP-100 to the platform in low Earth orbit, and environment where the local plasma is sufficient to cause breakdown of exposed conductors at potentials of only a few hundred volts. Its anticipated several years operation, and continuously accumulating exposure to meteoroids and debris, raises an increasing likelihood that mechanical damage, including perforation, will be sustained in service. The present concept employs an array of gas insulated solid wall aluminum coaxial tubes; a conceptual design which showed basic feasibility of the SP-100 powered space station. Practical considerations of launch, deployment and assembly have lead to investigation of reel deployable, dielectric insulated coaxial cables. To be competitive, the dielectric would have to operate reliably in a radiation environment under electrical stresses exceeding 50 kV/cm. The SP-100 transmission line high voltage interfaces are also considered. Author

N88-21252*# Gordon (Sanford), Cleveland, Ohio.
FINITE AREA COMBUSTOR THEORETICAL ROCKET PERFORMANCE
Sanford Gordon (Gordon, Sanford, Cleveland, Ohio) and Bonnie J. McBride Apr. 1988 18 p
(NASA-TM-100785; E-3975; NAS 1.15:100785) Avail: NTIS HC A03/MF A01 CSCL 21H

Previous to this report, the computer program of NASA SP-273 and NASA TM-86885 was capable of calculating theoretical rocket performance based only on the assumption of an infinite area combustion chamber (IAC). An option was added to this program which now also permits the calculation of rocket performance based on the assumption of a finite area combustion chamber (FAC). In the FAC model, the combustion process in the cylindrical chamber is assumed to be adiabatic, but nonisentropic. This results in a stagnation pressure drop from the injector face to the end of the chamber and a lower calculated performance for the FAC model than the IAC model. Author

N88-21253*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN EXPERIMENTAL INVESTIGATION OF AN ARCJET THRUSTER EXHAUST USING LANGMUIR PROBES M.S. Thesis
Lynnette M. Carney Apr. 1988 26 p
(NASA-TM-100258; E-3883; NAS 1.15:100258) Avail: NTIS HC A03/MF A01 CSCL 21H

Electrostatic (Langmuir) probes of both spherical and cylindrical geometry have been used to obtain electron number density and temperature in the exhaust of a laboratory arcjet. The arcjet thruster operated on nitrogen and hydrogen mixtures to simulate fully decomposed hydrazine in a vacuum environment with background pressures less than 5 x 10 to the -2 Pa. The exhaust appears to be only slightly ionized (less than 1 percent) with local plasma potentials near facility ground. The current-voltage characteristics of the probes indicate a Maxwellian temperature distribution. Plume data are presented as a function of arcjet operating condition and also position in the exhaust. Author

N88-21254*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER SYSTEMS FOR PRODUCTION, CONSTRUCTION, LIFE SUPPORT AND OPERATIONS IN SPACE
Ronald J. Sovie 1988 16 p Proposed for presentation at Space '88, Albuquerque, N. Mex., 29-31 Aug. 1988; sponsored by the American Society of Civil Engineers
(NASA-TM-100838; E-4026; NAS 1.15:100838) Avail: NTIS HC A03/MF A01 CSCL 22B

As one looks to man's future in space it becomes obvious that unprecedented amounts of power are required for the exploration, colonization, and exploitation of space. Activities envisioned include interplanetary travel and LEO to GEO transport using electric propulsion, Earth and lunar observatories, advance space stations, free-flying manufacturing platforms, communications platforms, and eventually evolutionary lunar and Mars bases. These latter bases would start as camps with modest power requirements (kWes) and evolve to large bases as manufacturing, food production, and life support materials are developed from lunar raw materials. These latter activities require very robust power supplies (MWes). The advanced power system technologies being pursued by NASA to fulfill these future needs are described. Technologies discussed will include nuclear, photovoltaic, and solar dynamic space power systems, including energy storage, power conditioning, power transmission, and thermal management. The state-of-the-art and gains to be made by technology advancements will be discussed. Mission requirements for a variety of applications (LEO, GEO, lunar, and Martian) will be treated, and data for power systems ranging from a few kilowatts to megawatt power systems will be represented. In addition the space power technologies being initiated under NASA's new Civilian Space Technology Initiative (CSTI) and Space Leadership Planning Group Activities will be discussed. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N88-21255# Oxford Univ. (England). Dept. of Engineering Science.
STUDIES OF TRAVERSE IMPACT DAMAGE IN COMPOSITE MATERIALS USING A HOPKINSON PRESSURE-BAR TECHNIQUE
R. K. Y. Li and J. Harding 1987 85 p Sponsored in cooperation with the United Kingdom Science and Engineering Research Council
(Grant AFOSR-0218-85)
(OUEL-1706/87; ETN-88-92037) Avail: NTIS HC A05/MF A01

Work on the transverse impact testing of fiber reinforced plastics is reviewed. An apparatus, using a Hopkinson-type instrumented input bar, is described and results presented for low-velocity impacts on plain-weave reinforced epoxy laminates with either all-carbon plies, all glass-plies, or various hybrid combinations of the two. Distinct differences in the damage mechanisms for the various hybrid laminate lay-ups are observed. ESA

N88-21256*# Christopher Newport Coll., Newport News, Va. Dept. of Physics.
DETECTION OF BONDLINE DELAMINATIONS IN MULTILAYER STRUCTURES WITH LOSSY COMPONENTS
Eric I. Madaras, William P. Winfree, B. T. Smith, and Joseph H.

Heyman [1988] 6 p
(Grant NAG1-431)
(NASA-CR-182716; NAS 1.26:182716) Avail: NTIS HC A02/MF A01 CSCL 11D

The detection of bondline delaminations in multilayer structures using ultrasonic reflection techniques is a generic problem in adhesively bonded composite structures such as the Space Shuttles's Solid Rocket Motors (SRM). Standard pulse echo ultrasonic techniques do not perform well for a composite resonator composed of a resonant layer combined with attenuating layers. Excessive ringing in the resonant layer tends to mask internal echoes emanating from the attenuating layers. The SRM is made up of a resonant steel layer backed by layers of adhesive, rubber, liner and fuel, which are ultrasonically attenuating. The structure's response is modeled as a lossy ultrasonic transmission line. The model predicts that the acoustic response of the system is sensitive to delaminations at the interior bondlines in a few narrow frequency bands. These predictions are verified by measurements on a fabricated system. Successful imaging of internal delaminations is sensitive to proper selection of the interrogating frequency. Images of fabricated bondline delaminations are presented based on these studies. Author

N88-21257*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HYGROTHERMOMECHANICAL FIBER COMPOSITE FATIGUE: COMPUTATIONAL SIMULATION
Carol A. Ginty and Christos C. Chamis 1988 13 p Presented at the 33rd International SAMPE Symposium and Exhibition, Anaheim, Calif., 7-10 Mar. 1988
(NASA-TM-100840; E-4029; NAS 1.15:100840) Avail: NTIS HC A03/MF A01 CSCL 11D

The technology of advanced composites has matured to the point where these composites are prime contenders for various structural applications. One of the major design considerations for prolonged service of these composites is fatigue due to cyclical hygral (moisture), thermal, and mechanical (hygrothermomechanical) loading conditions. Recent research activities at the NASA Lewis Research Center have led to the development of formal procedures for predicting, using computational simulation, fatigue in fiber composites due to cyclic hygrothermomechanical loading conditions. These formal procedures have subsequently been programmed into a computer module and embedded into the integrated Composites Analyzer (ICAN) computer code. The objective of this paper is to present and describe results obtained using the augmented ICAN computer code. Author

N88-21258# Royal Aircraft Establishment, Farnborough (England).
ENVIRONMENTAL EFFECTS ON THE POST-IMPACT COMPRESSIVE STRENGTH OF CFC
R. T. Potter Mar. 1987 26 p
(RAE-TM-MAT-STR-1088; BR102620; ETN-88-92040) Copyright Avail: NTIS HC A03/MF A01

The effects of elevated temperature and moisture on the postimpact compressive strength of carbon fiber composite (CFC) laminates made from three different fiber matrix systems were evaluated: flow controlled epoxy resin, cured with dicyandiamide (A), and two toughened epoxy resins (B and C). The strength at 120 C is reduced to about two-thirds to three-quarters of the value at room temperature, an amount which is similar to the environmentally-induced reductions in notched compressive strength. At all environmental conditions, compressive failure occurs by lateral growth of the impact-induced delaminations. However, at elevated temperature the axial extent of the delaminations is significantly reduced, provoking flexural failure of the fibers in the outermost plies. For systems B and C, moisture content at the time of impact is of no significance. For system A, subsequent hot/wet strength is slightly greater if the laminate was impacted wet. The volume of damage caused by a 10 J impact in the three fiber/matrix systems is similar, the principal difference being the extent of delamination affecting one or two plies at the rear face. ESA

N88-21259# Royal Aircraft Establishment, Farnborough (England).
AN INVESTIGATION OF THE MECHANICAL PROPERTIES OF IMPROVED CARBON FIBRE COMPOSITE MATERIALS
P. T. Curtis Apr. 1986 55 p
(RAE-TR-86021; RAE-MAT/STR-161; BR100538; ETN-88-92045) Copyright Avail: NTIS HC A04/MF A01

Tension, compression, shear, notch, impact, and fatigue tests were performed on 12 carbon fiber composite materials, ranging from standard carbon fiber reinforced epoxy systems to high strain and intermediate modulus carbon fibers with toughened epoxy, bismaleimide, and thermoplastic matrices. The improvement in mechanical properties of composite attainable through the use of these improved materials depends on the type of fiber and resin and their compatibility in the composite, as well as the interface between them. Thus improved materials should be selected on their overall system performance rather than individual fiber and resin behavior. None of the improved materials has increased compressive strength, particularly in the critical hot/wet and notched case, although most prove to be tougher than the standard materials. All of the tougher materials are more fatigue sensitive when tested in unidirectional form. The thermoplastic based system has the greatest resistance to impact, but the poorest fatigue performance and the properties of + or - 45 laminates show sensitivity to the rate of cooling after molding. ESA

N88-21260# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
STRENGTH AND FAILURE ANALYSIS OF COMPOSITE LAMINATE CONTAINING A CIRCULAR HOLE WITH REINFORCEMENT M.S. Thesis
Jong H. Lee Dec. 1987 116 p
(AD-A189629; AFIT/GAE/AA/87D-9) Avail: NTIS HC A06/MF A01 CSCL 11D

Tension and compression tests of quasi isotropic, graphite/epoxy laminate containing circular hole with reinforcement was conducted using the Instron static testing machine. Two types of reinforcement boundary conditions were investigated; adhesive band reinforcement and snug-fit unbonded plug. For each case boundary conditions, four different sizes of hole diameter and three types of reinforcing material (aluminum, plexiglass, steel) were employed for investigation. The experiments were mainly focused on the evaluation of ultimate strength of reinforced panel relative to the case of open hole. In addition to this, failure mechanism analysis for both boundary conditions were studied. To help designers and users of composite, previously available theoretical fracture models and their comparison with the present experimental results are also discussed. GRA

N88-21261# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: MATERIALS SCIENCE
9 Nov. 1987 99 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-87-009) Avail: NTIS HC A05/MF A01

Various U.S.S.R. materials science topics are discussed. Analysis and testing; coatings; composite materials; corrosion; ferrous metals; nonferrous metals, alloys, brazes and solders; nonmetallic materials; welding; brazing; soldering and mining are among the topics discussed. For individual titles, see N88-21262 through N88-21276.

N88-21262# Joint Publications Research Service, Arlington, Va.
WOVEN FRAMEWORKS FOR THREE-DIMENSIONAL REINFORCEMENT Abstract Only
A. M. Tolks, I. A. Repelis, M. P. Gaillite, and V. A. Kantsevich *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 21 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 795-799 Original language document was announced

in IAA as A87-25153 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The structure and properties of reinforcing frameworks with three-dimensionally arranged curvilinear reinforcing elements which can be produced by using traditional weaving technology are examined. Typical structural patterns of such frameworks are presented, and the effect of the weaving geometry and filament structure on the framework density is discussed. Calculations are made of the elastic constants of composites with all woven reinforcements. Author

N88-21263# Joint Publications Research Service, Arlington, Va.
THERMAL DEFORMATION AND STRENGTH OF COMPOSITE MATERIALS AT HIGH TEMPERATURES Abstract Only
G. N. Tretyachenko and L. I. Gracheva *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 22 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 800-805 Original language document was announced in IAA as A87-25154 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The thermodynamic relationships between specific heat and thermal expansion (compression) coefficients are examined for the case of nonmetallic degradable composites. For the uniaxial stressed state, a relationship is established between the temperature coefficient of linear expansion, alpha, and the elastic characteristics of composites. It is shown that the value of alpha depends not only on the composite structure but also on the composite fabrication process (e.g., heating conditions and the gas medium composition). It is further shown that, in the case of polymer and carbon composites subjected to purely thermal loading, the reliability of the calculated strength of composite structures increases as test conditions approach operating conditions. Author

N88-21264# Joint Publications Research Service, Arlington, Va.
STRUCTURE AND STRENGTH OF BORON-ALUMINUM COMPOSITES Abstract Only
S. T. Mileyko, F. Kh. Suleymanov, and N. S. Sarkisyan *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 22-23 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 811-819 Original language document was announced in IAA as A87-25155 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

Results of a systematic experiment designed to investigate the effect of various treatments (e.g., annealing) on the structure and strength of boron-aluminum composites are interpreted using a fracture model for metal-matrix composites with brittle-fiber reinforcement. An analysis of experimental data allows the structural interpretation of the parameters included in the model and the introduction of a temperature-time parameter describing the treatment. It is shown that the dependence of the B-Al composite strength on this parameter is nonmonotonic; the reasons for such a dependence and maximum strength condition are established. Author

N88-21265# Joint Publications Research Service, Arlington, Va.
CRACK RESISTANCE OF MULTILAYER CERAMIC-BASED COMPOSITE MATERIAL Abstract Only
S. M. Barinov, D. A. Ivanov, and G. A. Fomina *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 23 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 836-840 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The results of studies of the crack resistance and kinetics of the process of fracture in layered structure ceramic materials are discussed. Crack resistance characteristics were determined under bend test conditions in prism specimens with side notch on an Instron-1115 machine. Maximum critical stress intensity factor and specific effective work of fracture were achieved for aluminum oxide with layered structure. The fracture of the layered materials was discrete, accompanied by branching of cracks on interlayer boundaries and layered cell boundaries. Fracture of layered aluminum oxide material occurred in stages of acceleration and deceleration of crack growth due to changes in crack orientation with respect to the direction of application of maximum tensile stresses. Author

N88-21266# Joint Publications Research Service, Arlington, Va.
OPTIMAL FILAMENT SHELLS LOADED WITH INTERNAL PRESSURE IN A CENTRIFUGAL FORCE FIELD Abstract Only
c39
S. B. Cherevatskiy, V. M. Kotlyar, and S. G. Sidorin *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 24 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 859-864 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

A study is made of planning optimal network shells of rotation loaded with internal pressure, as well as shells in a field of centrifugal forces. The problem of designing the optimal shell is reduced to seeking the form of the meridian of the surface, the thread winding trajectory and forces in the network. Author

N88-21267# Joint Publications Research Service, Arlington, Va.
MONOLITHIC NATURE OF TRANSVERSELY REINFORCED COMPOSITES Abstract Only
V. T. Tomashevskiy, V. N. Shalygin, G. V. Dodin, R. S. Zinoyev, and A. N. Pimenov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 24 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 883-887 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The influence of supplementary transverse reinforcement by means of short-fiber microparticles on temperature stresses in a cylindrical reinforced shell as it is cooled following heating is studied by a finite difference method. Three factors were found to improve the monolithic properties of the products with the short transverse reinforcing elements: the increase in transverse tensile strength; the decrease in transverse tensile strength variation; and the decrease in effective temperature stresses. Author

N88-21268# Joint Publications Research Service, Arlington, Va.
STUDY OF STRENGTH CHARACTERISTICS OF GLASS-REINFORCED PLASTIC BY ACOUSTIC EMISSIONS METHOD Abstract Only
Ye. S. Pereverzev, D. G. Borshchevskaya, G. A. Bigus, V. G. Tikhiy, T. S. Tremba, and V. A. Limonov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 25 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 920-924 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

Results are presented from studies of the nature of fracture of glass reinforced plastic based on FO-1-1 knitted glass fabric and EDT-10 resin using data on acoustical activity. The effectiveness of quality control of products made from this material in testing is calculated. Specimens were loaded in uniaxial extension at 0.07 to 0.3 MPa/s with internal pressure 0.2 MPa/s as acoustical emissions were recorded. The frequency amplitude and shape of the acoustical pulses were considered. The acoustical pulses were found to reveal the nature of damage accumulating in the material in all stages of loading and to allow selection of critical recommendations for the use of this method for nondestructive testing of products and prediction of their strength properties. Large numbers of low energy pulses were recorded during break-up, delamination and rupture of knitted glass fibers, followed by higher power pulses emitted upon failure of the binder. Author

N88-21269# Joint Publications Research Service, Arlington, Va.
MICROPROBE EXAMINATION OF COMPOSITE MATERIALS PRODUCED BY BURNING OF Ti, Cr, C POWDERS WITH POWDER OF ANY ONE Fe-GROUP METAL Abstract Only
A. S. Rogachev, Yu. A. Galchenko, Z. G. Aslamazashvili, and A. N. Pityulin *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 25-26 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Neorganicheskiye Materialy (Moscow, USSR), v. 22, no. 11, Nov. 1986 p 1842-1844 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

A study of composite materials produced by burning of Ti, Cr, and C powder mixtures with powder of any one Fe-group metal was made for a determination of their phase composition and microstructure, these materials having properties comparable with those of WC-base alloys without containing dendritic tungsten. Cylindrical compacts 15 mm high and 80 mm in diameter were produced from commercial PTS titanium, PChS chromium, PM15TS carbon black, and PFeI iron, PniEli nickel, or PCoI cobalt powders. Application of a thermal pulse at one base initiated an exothermic reaction, gasless combustion, which then spontaneously propagated throughout the cylinder volume in the axial direction with a temperature of 2200 to 2800 K. Author

N88-21270# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF HEAT TREATMENT ON THE PROPERTIES OF BOROALUMINUM Abstract Only
B. A. Arefev and A. V. Rebrov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 27 Transl. into ENGLISH from Metallovedeniye i Termicheskaya Obrabotka Metallov (Moscow, USSR), no. 11, Nov. 1986 p 45-47 Original language document was announced in IAA as A87-29898 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The results of an experimental study of the effect of heat treatment on the mechanical properties of a rolled composite consisting of an AD1 aluminum alloy matrix reinforced by 140 micron diameter boron fibers with and without a 2 micron coating of B4C carbide are given. It was found that, generally, heat treatment reduces the transverse strength and increases the ductility of the rolled composite. The composite with boride coated boron fibers exhibits a higher strength than the composite with bare boron fibers after annealing above 500 C and therefore is recommended for high temperature applications. Author

N88-21271# Joint Publications Research Service, Arlington, Va.
THE PERCOLATION APPROACH AS A BASIS FOR EXPERIMENTAL RESEARCH ON THE MECHANICAL PROPERTIES OF COMPOSITE MATERIALS Abstract Only
R. A. Turusov, M. I. Gay, L. I. Manevich, V. G. Oshmyan, E. S. Zelenskiy, Z. P. Sulyayeva, and V. I. Sochnev *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 28 Transl. into ENGLISH from Doklady Akademii Nauk SSSR (Moscow, USSR), v. 291, no. 4, Dec. 1986 p 850-853 Original language document was announced in IAA as A87-29046 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The applicability of the concepts and methods of percolation theory to the description of the elastic properties of composite materials in relation to the component stiffness ratio is investigated experimentally. Results are presented for a plane model system consisting of an epoxy matrix with quasi-chaotically distributed steel cylinders. The results suggest that the percolation characteristics of the structure of composites with a chaotic distribution of a filler may affect the mechanical properties of the latter. The percolation concept does not provide a detailed explanation of the deformation mechanisms. Author

N88-21272# Joint Publications Research Service, Arlington, Va.
AN INVESTIGATION OF THE INFRARED EMISSION SPECTRA OF CARBON CONDENSATES Abstract Only **c72**
V. Ye. Strelnitskiy, A. I. Timoshenko, L. A. Gravel, and Yu. B. Novikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 55 Transl. into ENGLISH from Sverkhtverdyye Materialy (Kiev, USSR), no. 6, Nov. - Dec. 1986 p 7-12 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The infrared spectra of quasi-amorphous carbon condensates were studied to determine the nature of the interatomic bonds in the materials. In the thin diamond-like film, single tetrahedral carbon-hydrogen bonds predominated. There were no twin bonds and an insignificant number of triple bonds. With an increase in film thickness, unsaturated double and triple bonds formed. In the thin thermal films, all three types of bonds were present, with the unsaturated double and triple bonds predominating. As film thickness increased, the trigonal bonds became the primary type of bond. The bands generated by the hydrogenated carbon films were quite indistinct, but were consistant with a carbon matrix with twin and tetrahedral bonds. Emission infrared spectroscopy can be used to identify the types of interatomic bonds in carbon condensates. Author

N88-21273# Joint Publications Research Service, Arlington, Va.
THE UNIQUE CHARACTERISTICS OF THE STRUCTURE OF COMPOSITE MATERIALS MADE ON A BASE OF SPHALERITE-ANALOGOUS BORON NITRIDE Abstract Only **c72**
A. I. Ignatusha, A. V. Lysenko, V. G. Delevi, S. A. Bozhko, A. A. Svirid, Ye. S. Cherepenina, and N. G. Bagno *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 58 Transl. into ENGLISH from Sverkhtverdyye Materialy (Kiev, USSR), no. 6, Nov. - Dec. 1986 p 24-28 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

BN sub sph powder was sintered onto a substrate made of tungsten-free KKhN15 alloy in a toroidal high pressure apparatus. Nickel and an alpha-BN phase were found along with the primary beta-BN phase. Some of the individual inclusions of the metallic phase had a chromium concentration of 16 to 18 percent of the mass. The maximum concentration of nickel solute chromium was found where the BN sub sph layer conjoined with the substrate. A concentration of 0.1 to 0.5 percent chromium nitride was also found in the cutting layer. At a constant temperature, increased pressures were associated with a drop in the total nickel and alpha-BN content. The reverse was true when the sintering temperature was increased while pressure was held constant. Author

N88-21274# Joint Publications Research Service, Arlington, Va.
A DENSE AND STRONG CERAMIC MATERIAL MADE FROM ZIRCONIUM DIOXIDE Abstract Only **c27**
Ye. S. Lukin, M. G. Sukhikh, and V. N. Moiseyenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 59 Transl. into ENGLISH from Steklo i Keramika (Moscow, USSR), no. 12, Dec. 1986 p 15-16 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

Ceramic material made from partially stabilized zirconium dioxide containing 3 percent Y sub 2 O sub 3 was studied. The specimens were made by semi-dry pressing of powder with a particle size of 0.5 microns and sintering the material at 1200 to 1600 C with a holding period of five hours. X-ray phase analysis showed tetragonal, cubic, and a slight quality of monoclinic modifications of the zirconium dioxide present in the ceramic. Analysis showed that the ceramic was made of densely coalesced round grains. After firing at 1600 C, the specimens had an apparent density of close to 6.0 g/cm cubed, a flexural strength of 600 to 700 MPa, and a particle size of less than 1 micron. The heat resistance of the ceramic was also studied. Author

N88-21275# Joint Publications Research Service, Arlington, Va.
INCREASING THE RATE AT WHICH CERAMIC CASTINGS UNDERGO PRELIMINARY HEAT-TREATMENT IN AN ULTRA-HIGH FREQUENCY MAGNETIC FIELD Abstract Only **c27**
Ye. N. Prozorov and V. S. Glazachev *In its* JPRS Report:

Science and Technology. USSR: Materials Science 9 Nov. 1987 p 59-60 Transl. into ENGLISH from Steklo i Keramika (Moscow, USSR), no. 12, Dec. 1986 p 18-19 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

The ultra-high frequency pulse heating of ceramic castings was studied to determine whether this method could be used to extract the binder from the ceramic body. To improve the dielectric properties of the specimens and improve their ability to absorb the energy, glycerin in the amount of 2 percent and 7 percent of the mass of the dry body was added to the slip. In the first series of tests, which were done at low temperatures, pulse length was 60 s, and the pulses were 10 to 120 s apart. These tests showed that up to 10 percent of the binder was drawn off through the porous substrate in liquid form and, as a result, the viscosity of the system and the strength of the castings increased. In the second series, the castings were held at a temperature of 60 C for 15 to 20 minutes before carrying out the basic binder extraction process. The pulses lasted 30 s and were 4 to 5 minutes apart. With a pulse length of 60 s, most of the binder was drawn out within 3.5 hours. Less stringent heating conditions required more time for the extraction of the binder. Author

N88-21276# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF HYDROGEN ON CRACK FORMATION TENDENCY IN HEAT-AFFECTED ZONE WITH STRESS CONCENTRATOR Abstract Only **c26**
B. S. Kasatkin, O. D. Smiyan, V. Ye. Mikhaylov, V. V. Volkov, Ye. I. Butkova, and V. V. Makarov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 82-83 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 11, Nov. 1986 p 20-23 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

A study was made of the influence of plastic deformation in the area of a stress concentrator on the distribution of hydrogen in a welded joint. Simultaneous hydrogen absorption and loading of the specimens resulted in delayed failure. The stress concentrators caused nonuniform distribution of hydrogen in the steel. The maximum hydrogen concentration was found in advance of the leading edge of local plastic deformation, well in advance of the developing crack. The logarithm of incubation period varied linearly as a function of hydrogen concentration in advance of the tip of the notch. Author

N88-21315# Joint Publications Research Service, Arlington, Va.
PHENOMENOLOGICAL PIERCING CHARACTERISTICS OF COMPOSITE MATERIALS Abstract Only
V. P. Muzychenko and V. I. Postnov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 15 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 62-66 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21349# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL STRESS ANALYSIS OF COMPOSITE MATERIALS
Shuangyin Zhang *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 100-115 Transl. into ENGLISH from Zhongguo Kexue (A Ji) (Beijing, Peoples Republic of China), no. 3, Mar. 1987 p 292-303 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21500*# Akron Univ., Ohio.
A VISCOPLASTIC CONSTITUTIVE THEORY FOR METAL MATRIX COMPOSITES AT HIGH TEMPERATURE
David N. Robinson, Stephen F. Duffy (Cleveland State Univ., Ohio.), and John R. Ellis *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 7-25 Previously announced as N87-13790 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-21277# Princeton Univ., N. J. Dept. of Chemistry.
OXIDE-BOUND TRANSITION METAL COMPLEXES FOR METHANE ACTIVATION Annual Report, 1 Sep. 1986 - 31 Aug. 1987
J. Schwartz 23 Oct. 1987 11 p
(Contract GRI-5086-260-1329)
(PB88-169719; GRI-88/0002) Avail: NTIS HC A03/MF A01 CSCL 07D

New methodology was developed for a model oxidation system for directly converting rhodium bis(allyl) or rhodium dihydride complexes to dioxygen or ozone adducts. Rhodium(oxygen) complexes and rhodium(ozone) complexes were prepared on either alumina or silica. Iridium analogs were prepared on silica. A series of heteropolyoxy anionic (HPA) complexes of rhodium were prepared involving both di(carbonyl) and dioxygen adducts. A crystal of TiO2 was prepared for surface studies and excellent UPS data for deposition and chemical transformations of organorhodium compounds were obtained. Angular dependent UPS spectroscopy is being developed to enable UHV techniques to assist in structural characterization of complexes on oxide surfaces. Author

N88-21278# Pennsylvania State Univ., University Park.
BASIC RESEARCH ON NATURAL GAS COMBUSTION PHENOMENA Annual Report, Jun. 1986 - Aug. 1987
M. Frenklach and W. C. Gardiner 15 Sep. 1987 82 p
(Contracts GRI-5086-260-1307; GRI-5086-260-1320)
(PB88-168380; GRI-87/0338) Avail: NTIS HC A05/MF A01 CSCL 07D

The objective of the research is to develop a universal chemical kinetic model for the combustion and ignition of methane in terms of elementary chemical reactions with rates specified as functions of temperature and pressure. During the past year, researchers completed data analysis on methyl radical profiles during shock initiated ignition of methane-oxygen mixtures, including the pressure based ignition histories in the same runs; compiled a revised mechanism for methane combustion and completed a first round of joint parameter optimization on the mechanism using the new CH3 profiles and older methane ignition data. Author

N88-21279 National Physical Lab., Teddington (England). Div. of Materials Applications.
QUANTITATIVE AES: THE ESTABLISHMENT OF A STANDARD REFERENCE SPECTRUM FOR THE ACCURATE DETERMINATION OF SPECTROMETER TRANSMISSION FUNCTIONS
G. C. Smith and M. P. Seah Sep. 1987 19 p
(NPL-DMA(A)151; ISSN-0142-7313; ETN-88-91908) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The simple theories used for much practical quantitative Auger electron spectroscopy (AES) are shown to be valid for the intensities of the 60 and 915 eV Auger electron peaks from solid copper as a function of the electron beam angle of incidence (AI) and, for the 915 eV peak, as a function of the angle of emission (AE). The whole direct spectrum shape is relatively insensitive to AE but does depend sensitively on AI. To establish a standard direct spectrum to intercompare and calibrate spectrometer intensity/energy scales, AI is fixed at 30 deg while AE is defined by the spectrometer geometry. In order to obtain an absolute energy spectrum without the modifying functions usually introduced by the spectrometer the spectra obtained in the constant Delta

E/E mode are divided by the function ED(E). Here D(E) is taken as the smooth theoretical function generated with one experimentally determined parameter, the energy of the secondary emission maximum in the multiplier, Em; Em is deduced from the experimental determination of D(E) by ratioing the constant Delta E/E spectrum with the multiplier operational to that with it used as a Faraday cup. A range of validity tests shows the procedure to be effective. This approach is used to produce the standard spectrum for copper foil, using a 5 keV electron beam incident at 30 deg to the surface normal and which contains no contributions from the spectrometer or detector energy-dependent efficiencies. ESA

N88-21280# Technische Hochschule, Aachen (West Germany). Lehrstuhl fuer Reaktortechnik.
USE OF NONPOROUS METALS MEMBRANES FOR THE SEPARATION OF HYDROGEN FROM GAS MIXTURES Final Report, Dec. 1985
Walter Weirich, Michael Oertel, and Uwe Vlinkelmann Bonn, Fed. Republic of Germany BMFT Dec. 1986 62 p In GERMAN; ENGLISH summary Sponsored by BMFT, Bonn, Fed. Republic of Germany
(BMFT-FB-T-86-206; ISSN-0340-7608; ETN-88-91938) Avail: NTIS HC A04/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 13 Deutsche marks + MWST

To avoid using high cost palladium alloys for hydrogen separation, membranes were manufactured from niobium, tantalum and vanadium, each coated with a palladium alloy, and from a TiNi-alloy. The influence of production procedure and the other gases (CH4, CO2, CO, N2) on hydrogen permeation was investigated at temperatures between 300 and 750 C and at hydrogen pressures ranging from 0.1 to 5 bars. Under these conditions niobium and tantalum tend towards hydrogen-embrittlement, vanadium membranes are mechanically stable above 340 C, and membranes made of TiNi are not destroyed, if they first undergo a suitable annealing pretreatment. The permeation rates of Ni-coated TiNi-membranes at 750 C are lower by a factor of 10 than those of palladium-membranes. Nitrogen causes the greatest reduction of hydrogen permeation (24 percent) through coated vanadium-membranes. Depending on experimental conditions, permeation rates 2.9 to 4.6 times higher than those of palladium-membranes of the same dimensions are possible. ESA

N88-21281# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Energetics Dept.
[ACTIVITIES REPORT OF THE ENERGETICS DEPARTMENT] Annual Report, 1986
Sep. 1987 31 p Original contains color illustrations
(ETN-88-91981) Avail: NTIS HC A03/MF A01

One-sided schemes with parametrized flux splitting for simulating transonic flows; numerical simulation of three-dimensional flows in axial/radial turbomachines; unsteady three-dimensional flow in the manifold and cylinder of a diesel engine; modeling of the combustion instabilities of solid fuel boosters; numerical simulation of reactive flow in shock tube; and modeling of a diffusion flame rolled up by a vortex are discussed. Experimental study of the flow at the throat and outlet of a transonic centrifugal compressor diffuser; simulation of the flow in a nozzleless booster; application of semiconductor laser spectroscopy to studies of combustion; and measurement of temperature deviations from chemical equilibrium in a turbulent diffusion flame are described. A setup for studying aerodynamic injection of kerosene at 40 bar and 1000 K into a combustor in combustion; ultrasonics applied in measuring unsteady rates of liquid flow; high frequency instabilities of the Viking engine; and tests for the ignition system of the HM7B cryogenic engine are outlined. ESA

N88-21282*# National Aeronautics and Space Administration, Washington, D.C.
COPPER PEROXIDE
L. Moser May 1988 28 p Transl. into ENGLISH from Zeitschrift fuer Anorganische und Allgemeine Chemie (Fed. Republic of Germany) v. 54, no. 121, 1907 p 121-140 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20245; NAS 1.77:20245) Avail: NTIS HC A03/MF A01 CSCL 07D

A number of oxidizing agents, including chlorine, bromine, ozone and other peroxides, were allowed to act on copper solutions with the intention of forming copper peroxide. The only successful agent appears to be hydrogen peroxide. It must be used in a neutral 50 to 30 percent solution at a temperature near zero. Other methods described in the literature apparently do not work. The excess of hydrogen must be quickly sucked out of the brown precipitate, which it is best to wash with alcohol and ether. The product, crystalline under a microscope, can be analyzed only approximately. It approaches the formula CuO2H2O. In alkaline solution it appears to act catalytically in causing the decomposition of other peroxides, so that Na2O2 cannot be used to prepare it. On the addition of acids the H2O2 is regenerated. The dry substance decomposes much more slowly than the moist but is not very stable. Author

N88-21283 British Library Lending Div., Boston Spa (England).
KINETICS OF COMBUSTION OF FINELY DIVIDED SOLID FUEL IN GRANULES
D. A. Kovalev and O. A. Gogenko 1987 3 p Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy Chernaya Metallurgiya (USSR), no. 7, 1987 p 165-166
(BLL-M-37626-(5828.4)) Avail: British Library Lending Div., Boston Spa, United Kingdom

A brief examination is made of the results of experiments conducted on a thermogravimetric unit to investigate the influence of the filtration rate of the heat carrier on the burnout rate of carbon from granules of different size. Author

N88-21284# Lawrence Livermore National Lab., Calif.
NUMERICAL SIMULATION OF TURBULENT PREMIXED COMBUSTION AND DECAY OF TURBULENT SWIRLING FLOW
L. D. Cloutman 27 Jan. 1988 11 p
(Contract W-7405-eng-48)
(DE88-006588; UCID-21316) Avail: NTIS HC A03/MF A01

The results of the numerical simulation of three experiments with the CONCHAS-SPRAY and KTVA hydrodynamics programs are presented. Both codes are shown to give acceptable accuracy, although it would be desirable to improve the turbulence models and turbulent combustion rate model. DOE

N88-21285# Argonne National Lab., Ill.
TECHNIQUES FOR STUDYING FAST REACTIONS IN LIQUIDS
C. D. Jonah 1987 14 p Presented at the 42nd International Meeting on Chemical Reactivity in Liquids-Fundamental Aspects, Paris, France, 7 Sep. 1987
(Contract W-31-109-eng-38)
(DE88-005917; CONF-8709247-1) Avail: NTIS HC A03/MF A01

The goal of this paper is to summarize the many techniques which can be used for making fast measurements so that the reader will be able to see which techniques are suitable for his or her particular purpose. In this paper, any reaction that is faster than 1 second is to be considered a fast reaction. Also because there is a paper in this volume which reviews techniques which have time resolutions in the picosecond and femtosecond time range, a few comments are made based on recent work at Argonne in picosecond pulse radiolysis. The ultimate limits of these techniques will not be discussed in detail, because (1) not all of the many techniques are known (2) the novice user is unlikely to be well-served by knowing what is possible after 20 years of refining the technique in a given lab. The limitations and major difficulties of the techniques will be mentioned. DOE

N88-21286# Purdue Univ., West Lafayette, Ind. Flame Diagnostics Lab.
MEASUREMENT OF SPECIES CONCENTRATIONS IN FLAMES BY LASER-INDUCED FLUORESCENCE Progress Report, 1 Jan. 1986 - 31 Dec. 1987
J. T. Salmon, D. L. Peterson, F. E. Lytle, and N. M. Laurendeau Mar. 1988 23 p
(Contract DE-FG02-85ER-13395)
(DE88-007096; DOE/ER-13395/2) Avail: NTIS HC A03/MF A01

This report describes work accomplished in the last two years on measurement of species concentrations in flames via laser-induced fluorescence. During this period, we have developed a new quenching-independent method for obtaining quantitative measurements of atomic hydrogen concentration. The technique, labeled photoionization controlled-loss spectroscopy (PICLS), employs two-photon absorption followed by photoionization of the excited-state atoms. A new monochromatic temperature probe has also been developed which makes use of the anomalous fluorescence of pyrene. In this case, a local vibrational temperature can be measured using a single laser beam by monitoring the fluorescence ratio from the first and second excited states of the pyrene molecule. DOE

N88-21287# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF LASER-INDUCED FLUORESCENCE IN AN ATMOSPHERIC-PRESSURE BORON-SEEDED FLAME Ph.D. Thesis
Greg R. Schneider Dec. 1987 161 p
(AD-A189631; AFIT/DS/PH/87-4) Avail: NTIS HC A08/MF A01 CSCL 21B

The purpose of this research was to demonstrate the feasibility of using laser-induced fluorescence (LIF) of boron oxide radicals in atmospheric-pressure flames. Such a demonstration would provide a useful tool with which to probe the detailed combustion chemistry of boron fuels. The radical species sought were BO2 and BO, both having spectra in the visible region of the spectrum. These two species are believed to play critical roles in the boron combustion process. A CH4/air/O2 flame was seeded with BC13 producing the green emission characteristic of boron flames. Unfortunately, it also created significant quantities of aerosols of solid boric acid from the reaction of the BC13 with the water vapor in the building air used in the flame. The burner was 1 cm in diameter and composed of approximately 60 capillary tubes. The burner could be remotely translated in two directions permitting investigation of different regions of the flame. GRA

N88-21288# Allied Bendix Aerospace, Kansas City, Mo.
COMPARISON OF ISOPROPYL ALCOHOL AND TRICHLOROETHYLENE IN REMOVING SOLDER FLUX
M. G. Benkovich Jan. 1988 21 p
(Contract DE-AC04-76DP-00613)
(DE88-005556; BDX-613-3878) Avail: NTIS HC A03/MF A01

This work evaluated a nontoxic solvent for its ability to remove solder flux as compared to trichloroethylene solvent. Isopropyl alcohol was evaluated for its cleaning efficiency for solder flux removal using a high pressure spray process (minimum spray pressure of 80 psig). Cleanliness levels were measured by the Meseran Surface Analyzer. Test samples also underwent gas chromatograph/mass spectrometer analysis and were visually inspected under a longwave ultraviolet lamp. Detailed analyses of flux removal by the two solvents were made as related to solder flux types, solder flux diluted by 50 percent with isopropyl alcohol, and solder process conditions. GRA

N88-21807# University of Electro-Communications, Tokyo (Japan). Dept. of Engineering Physics.
WHAT HAS BEEN DONE AND WHAT WILL BE DONE BY SUBNATURAL LINEWIDTH SPECTROSCOPY
Hiroshi Takuma, Kazuko Shimizu, and Fujio Shimizu (Tokyo Univ., Japan) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 503-530 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-21289# California Univ., Berkeley. Lawrence Berkeley Lab.
AN INVESTIGATION OF THE INFLUENCE OF DISLOCATION SUBSTRUCTURES ON THE DEFORMATION BEHAVIOR OF AK, DQ STEEL SHEETS Ph.D. Thesis
S. A. Vincent Dec. 1987 69 p
(Contract DE-AC03-76SF-00098)
(DE88-006337; LBL-24443) Avail: NTIS HC A04/MF A01

Purpose of this study was to observe the effect of dislocation substructure on the deformation behavior of low carbon steel sheet, and to search this information for clues about the effects of these substructures on work hardening behavior. The method included first developing different types of substructures in otherwise identical specimens by prestraining at different temperatures. These specimens were then subjected to continued deformation at the same temperature. The tensile behavior was then analyzed, bearing in mind the substructural changes, in an effort to improve the fundamental understanding of the deformation process. DOE

N88-21290# Bureau voor Technisch-Economische Advisering aan Industrie en Handel, Hague (Netherlands).
METALS. PRELIMINARY STUDY FOR AN INNOVATION-ORIENTED RESEARCH PROGRAM (IOP) [METALEN. VOORSTUDIE VOOR EEN INNOVATIEGERICHT ONDERZOEKSPROGRAMMA]
M. G. Borst and G. J. M. vanAmelsvoort Jun. 1986 102 p In DUTCH Sponsored by the Ministerie van Economische Zaken, The Netherlands
(ETN-88-91317) Avail: NTIS HC A06/MF A01

A study of metal working was performed, aiming at improving the competitiveness of Dutch small and medium supply industries. Metal forming and welding are emphasized. The economic significance of metal working for the Netherlands is depicted. International trends in metal working research, and the relevant research projects at Dutch universities, colleges, and large institutes of technology are presented. The interest of the industry for academic research is described. Subjects for an IOP, and proposals for realizations are given. ESA

N88-21291# Bureau voor Technisch-Economische Advisering aan Industrie en Handel, Hague (Netherlands).
INNOVATION-ORIENTED RESEARCH PROGRAM (IOP) METALS. ANNEXES [IOP-METALEN. BIJLAGEN]
1987 107 p In DUTCH
(ETN-88-91318) Avail: NTIS HC A06/MF A01

Annexes to a metal working investigation are presented. Publications of the Ministry of Economic Affairs concerning IOP's and stimuli for strategic scientific research are summarized. Research projects are proposed. A proposal for a preliminary study of IOP-metals and alloys is explained. Specific problems of cold forging are discussed. ESA

N88-21292# Centro Informazioni Studi Esperienze, Milan (Italy).
FRACTURE TOUGHNESS CHARACTERIZATION OF SA508 AND SA533B RPB STEELS
C. Fossati and S. Ragazzoni 1987 37 p Presented at the French-Italian Joint Meeting on Fracture Mechanics Applied to the Safety of Large Structures, Bordighera, Italy, 14-15 May 1987
(CISE-3908; ETN-88-91875) Avail: NTIS HC A03/MF A01

A program on fracture toughness characterization of reactor pressure vessel steels is described. Different steels and different heats of the same steel are tested to obtain a database to be used to support surveillance programs. Data obtained on an SA508

C12 forging, two SA533B C11 plates, and a submerged arc weld in SA533B are presented. Static and dynamic fracture toughness of base metals, weld, and heat affected zone were measured in the temperature range minus 196 to plus 300 C. Compact and precracked Charpy V-notch specimens were used in static and dynamic tests respectively. ESA

N88-21293 National Physical Lab., Teddington (England). Div. of Materials Applications.
THE EFFECT OF H2S CONCENTRATION AND pH ON HYDROGEN PERMEATION IN AISI 410 STAINLESS STEEL IN 5 PERCENT NaCl
A. Turnbull, M. SaenzdeSantaMaria, and N. D. Thomas Sep. 1987 29 p
(NPL-DMA(A)148; ISSN-0143-7313; ETN-88-91906) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The permeation of hydrogen atoms in AISI 410 stainless steel in 5 percent NaCl containing varying levels of dissolved H2S at pH values between 2.6 and 4.6 was measured. Two tests were conducted for H2S-saturated sea water. Hydrogen permeation currents increase with increasing H2S and decreasing pH, as expected, but the permeation transients are strongly influenced by irreversible and reversible trapping. Calculation of a diffusion coefficient is thus not readily possible based on simple Fickian diffusion theory. A thickness-normalized flux is considered the best interim method for characterizing the charging efficiency of different environments. ESA

N88-21294 National Physical Lab., Teddington (England). Div. of Materials Applications.
THE EFFECT OF H2S CONCENTRATION AND pH ON THE CRACKING RESISTANCE OF AISI 410 STAINLESS STEEL IN 5 PERCENT BRINE
M. SaenzdeSantaMaria and A. Turnbull Sep. 1987 39 p
(NPL-DMA(A)149; ISSN-0143-7313; ETN-88-91907) Copyright Avail: National Physics Laboratory Teddington, Middlesex, TW11 0LW, United Kingdom

The slow strain rate method was used to characterize the cracking resistance of AISI 410 stainless steel (commonly used for downhole applications) in 5 percent NaCl containing varying levels of dissolved H2S at pH values of 2.6 and 3.6. Cracking resistance of the material is best described by the measured time-to-failure. The cracking mechanism is associated with absorbed hydrogen and the time to failure is related to the thickness-normalized flux of hydrogen atoms. Tests were also carried out in ASTM sea water saturated in H2S and in 3.5 percent NaCl solution at an equivalent pH of 5.0. Cracking in these latter environments is associated with pitting and is considered to be dependent on hydrogen generated locally at the pit site. The results demonstrate that the slow strain rate technique can be a useful tool in a preliminary assessment of the aggressivity of the complex and variable environments associated with formation waters. ESA

N88-21295*# Case Western Reserve Univ., Cleveland, Ohio.
PROCESSING, PHYSICAL METALLURGY AND CREEP OF NiAl + Ta AND NiAl + Nb ALLOYS Ph.D. Thesis. Final Contractor Report
Viren M. Pathare Apr. 1988 190 p
(Grant NAG3-387)
(NASA-CR-182113; NAS 1.26:182113) Avail: NTIS HC A09/MF A01 CSCL 11F

Powder processed NiAl + Ta alloys containing 1, 2, and 4.5 at percent tantalum and NiAl + Nb alloys containing 1 and 2 at percent niobium were developed for improved creep properties. In addition, a cast alloy with 5 at percent tantalum was also studied. Hot extrusion parameters for processing alloys with 1 and 2 at percent of tantalum or niobium were designed. The NiAl + 4.5 at percent Ta alloy could be vacuum hot pressed successfully, even though it could not be extruded. All the phases in the multiphase alloys were identified and the phase transformations studied. The Ni2AlTa in NiAl + 4.5 at percent Ta alloy transforms into a liquid phase above 1700 K. Solutionizing and annealing below this temperature gives rise to a uniform distribution of fine second phase precipitates. Compressive creep properties were evaluated at 1300 K using constant load and constant velocity tests. In the higher strain rate region single phase NiAl + 1 at percent Ta and NiAl + 1 at percent Nb alloys exhibit a stress exponent of 5 characteristic of climb controlled dislocation creep. In slower strain rate regime diffusional creep becomes important. The two phase alloys containing 2 to 5 at percent Ta and 2 at percent Nb show considerable improvement over binary NiAl and single phase alloys. Loose dislocation networks and tangles stabilized by the precipitates were found in the as crept microstructure. The cast alloy which has larger grains and a distribution of fine precipitates shows the maximum improvement over binary NiAl. Author

N88-21296*# National Aeronautics and Space Administration, Washington, D.C.
ON THE THEORY OF THE CONVERSION OF METALLIC MIXED PHASES. 5: FLUCTUATIONS AND NUCLEATION IN SUB-COOLED PHASES
G. Borelius May 1988 19 p Transl. into ENGLISH from Annalen der Physik (Fed. Republic of Germany), v. 5, no. 33, 1948 p 517-531 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20249; NAS 1.77:20249) Avail: NTIS HC A03/MF A01 CSCL 11F

A comparison is made between fluctuation-theoretical calculations and empirical results. Concentration fluctuations and the resulting separation, and the distribution function of the reversible fluctuations are approximately calculated. The relation of this distribution to the concentration-dependence of the free energy is discussed. Possible effects of fluctuations are discussed, and other attempts to explain the sub-cooling are described. Author

N88-21297*# National Aeronautics and Space Administration, Washington, D.C.
ELECTRON DIFFRACTION EVIDENCE FOR THE ORDERING OF EXCESS NICKEL ATOMS BY RELATION TO STOICHIOMETRY IN NICKEL-RICH BETA'-NiAl FORMATION OF A NICKEL-ALUMINUM (Ni2Al) SUPERLATTICES
F. Reynaud May 1988 14 p Transl. into ENGLISH from Journal of Applied Crystallography (France), v. 9, pt. 4, 1976 p 263-268 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20177; NAS 1.77:20177) Avail: NTIS HC A03/MF A01 CSCL 11F

In electron diffraction patterns of nickel-rich beta-NiAl alloys, many anomalies are observed. One of these is the appearance of diffuse intensity maxima between the reflexions of the B2 structure. This is explained by the short-range ordering of the excess nickel atoms on the simple cubic sublattice occupied only by aluminum atoms in the stoichiometric, perfectly ordered NiAl alloy. After annealing Ni 37.5 atomic percent Al and Ni 37.75 atomic percent Al for 1 week at 300 and 400 C, the diffuse intensity maxima transformed into sharp superstructure reflexions. These reflexions are explained by the formation of the four possible variants of an ordered hexagonal superstructure corresponding to the Ni2Al composition. This structure is closely related to the Ni2Al3 structure (same space group) formed by the ordering of vacancies on the nickel sublattice in aluminum-rich beta-NiAl alloys. Author

N88-21298 British Library Lending Div., Boston Spa (England).
EDDY CURRENT LOSSES INDUCED BY ROTATION OF MAGNETISATION
S. E. Sokolovskii 1987 3 p Transl. into ENGLISH from Vysshikh Uchebnykh Zavedeniy Chernaya Metallurgiya (USSR), no. 7, 1987 p 172
(BLL-M-37634-(5828.4)) Avail: British Library Lending Div., Boston Spa, United Kingdom

An examination was made of plane-magnetized sheet material. An expression was developed which relates the magnitude of the eddy current losses with the magnetization conditions and the parameters of the material. Author

N88-21299# Army Belvoir Research and Development Center, Fort Belvoir, Va.
RUST CONVERTERS Final Technical Report, 1 Oct. 1985 - 30 Sep. 1987
Dario A. Emeric, Bryan Westich, and Richard C. McNeil Nov. 1987 27 p
(AD-A188767; BRDEC-2457) Avail: NTIS HC A03/MF A01

To supplement the war against corruption, the Chemistry Research Group, Materials, Fuels and Lubricants, Belvoir Research, Development and Engineering Center, is currently developing a rust converter suitable for military applications. After an initial screening process, the best commercially available rust converters were evaluated over field and laboratory pre-corroded cold rolled steel and galvanized panels. Following through laboratory and field examination it was determined that currently available rust converters actually accelerated corrosion after a period of time, rather than retarding it. GRA

N88-21276# Joint Publications Research Service, Arlington, Va.
INFLUENCE OF HYDROGEN ON CRACK FORMATION TENDENCY IN HEAT-AFFECTED ZONE WITH STRESS CONCENTRATOR Abstract Only
B. S. Kasatkin, O. D. Smiyan, V. Ye. Mikhaylov, V. V. Volkov, Ye. I. Butkova, and V. V. Makarov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 82-83 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 11, Nov. 1986 p 20-23 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21313# Joint Publications Research Service, Arlington, Va.
EFFECT OF NONUNIFORM STATE OF THERMAL STRESS ON RESISTANCE OF EI826 ALLOY TO THERMAL FATIGUE Abstract Only
G. R. Semenov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 1 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 71-75 Original language document was announced in IAA as A87-17464 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21316# Joint Publications Research Service, Arlington, Va.
DEPENDENCE OF HYDROGEN EMBRITTLEMENT OF AUSTENITIC STAINLESS STEELS ON STRUCTURAL STATE OF GRAIN BOUNDARIES
P. A. Platonov, Yu. R. Kevorkyan, and I. Ye. Tursunov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 16-17 Transl. into ENGLISH from Fiziko-Khimicheskaya Mekhanika Materialov (Kiev, USSR), v. 22, no. 4, Jul. - Aug. 1986 p 23-26 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21317# Joint Publications Research Service, Arlington, Va.
SOME STRUCTURAL ASPECTS OF CRACK PROPAGATION IN HEAT-RESISTANT STEELS UNDER CYCLIC THERMAL AND MECHANICAL LOAD Abstract Only
S. I. Tishayev, G. A. Kotelnikov, R. G. Miftakhov, and T. V. Tetyuyeva *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 26-27 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 13-17 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21318# Joint Publications Research Service, Arlington, Va.
GROWTH OF FATIGUE CRACKS IN NICKEL ALLOYS AT HIGH TEMPERATURES Abstract Only
V. T. Troshchenko, A. Ya. Krasovskiy, V. N. Yezhov, I. V. Kramarenko, A. V. Prokopenko, and I. A. Makovetskaya *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 32 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 3-7 Original language document was announced in IAA as A87-17459 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21326# Joint Publications Research Service, Arlington, Va.
STRUCTURE AND PROPERTIES OF WELDED JOINTS PRODUCED BETWEEN NIOBIUM PARTS IN CONTROLLABLE HELIUM ATMOSPHERE Abstract Only
G. A. Petrunin, A. M. Lyubchik, N. F. Chugay, Ye. A. Asnis, and M. M. Nerodenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 69 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 10, Oct. 1986 p 21-24 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21329# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF JOINT FORMATION DURING FRICTION WELDING OF Ti ALLOYS TO Nb ALLOYS Abstract Only
I. M. Fedorenko, V. T. Bondar, B. D. Buts, and I. M. Yushchenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 72-73 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 6-7 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21480*# Lockheed Space Operations Co., Cocoa Beach, Fla.
CONTROLLING STRESS CORROSION CRACKING IN MECHANISM COMPONENTS OF GROUND SUPPORT EQUIPMENT
W. A. Majid *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 163-174 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 11F

N88-21499*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
THE VISCOPLASTICITY THEORY BASED ON OVERSTRESS APPLIED TO THE MODELING OF A NICKEL BASE SUPERALLOY AT 815 C
E. Krempl, H. Lu, and D. Yao *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 1-5 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21501*# General Electric Co., Cincinnati, Ohio.
DEVELOPMENT OF A UNIFIED CONSTITUTIVE MODEL FOR AN ISOTROPIC NICKEL BASE SUPERALLOY RENE 80
V. G. Ramaswamy, R. H. VanStone, J. H. Laflen, and D. C. Stouffer (Cincinnati Univ., Ohio.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 27-35 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21502*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
MODELING THE VISCOPLASTIC BEHAVIOR OF INCONEL 718 AT 1200 F
M. S. Abdel-Kader (Military Technical Coll., Cairo, Egypt), J. Eftis, and D. L. Jones *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 37-68 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21503*# Massachusetts Inst. of Tech., Cambridge.
AN INTERNAL VARIABLE CONSTITUTIVE MODEL FOR THE LARGE DEFORMATION OF METALS AT HIGH TEMPERATURES
Stuart Brown and Lallit Anand *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 69-75 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21510*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Engineering Mechanics.
A CONSTITUTIVE MODEL WITH DAMAGE FOR HIGH TEMPERATURE SUPERALLOYS
J. A. Sherwood and D. C. Stouffer *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 187-200 Sponsored in part by AF (For primary document see N88-21498 14-39)
(Grant NAG3-511)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21512*# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
DATA REQUIREMENTS TO MODEL CREEP IN 9Cr-1Mo-V STEEL
R. W. Swindeman *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 217-223 Previously announced as N87-12944 (For primary document see N88-21498 14-39)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21513*# Washington State Univ., Pullman. Dept. of Mechanical Engineering.
CONTROLLED-STRAIN RATE TESTS AT VERY LOW STRAIN RATES OF 2618 ALUMINUM AT 200 C
J. L. Ding and S. R. Lee *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 225-238 (For primary document see N88-21498 14-39)
(Grant NSF MEA-84-029)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21514*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
CYCLIC UNIAXIAL AND BIAXIAL HARDENING OF TYPE 304 STAINLESS STEEL MODELED BY THE VISCOPLASTICITY THEORY BASED ON OVERSTRESS
David Yao and Erhard Krempl *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 239-245 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

N88-21517*# Georgia Inst. of Tech., Atlanta. Fracture and Fatigue Research Lab.
THE EFFECTS OF TEMPERATURE AND STRAIN RATE ON THE YIELDING BEHAVIOR OF THE SINGLE CRYSTAL SUPERALLOY PWA 1480
Walter W. Milligan and Stephen D. Antolovich *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 291-294 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N88-21300# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
PARTIAL DISCHARGES AND THE ELECTRICAL AGING OF CROSS LINKED POLYETHENE (XLPE) CABLE INSULATION
G. G. Wolzak, A. M. F. J. vandeLaar, and E. F. Steennis Nov. 1986 26 p Sponsored by Kema N.V., Arnhem, Netherlands
(EUT-86-E-160; ISBN-9-06-144160-9; ISSN-0167-9708; ETN-88-91807) Avail: NTIS HC A03/MF A01

The relationship between partial discharges and electrical aging of XLPE cable insulation was studied, and a method for the detection and localization of small partial discharges (less than 1 pC) in high voltage cables was developed. Test cables were aged for 6 months at a stress of 15 kV/mm rms at the conductor; 3 cables were held at room temperature and 3 were heated to 90 C conductor temperature. Partial discharge, tan delta, breakdown voltage, and physical and chemical properties were measured. The results show no significant aging and therefore no correlation between aging and partial discharge activity could be established. ESA

N88-21301# Atlanta Univ., Ga.
CERAMIC MATERIALS FROM PRECERAMIC ORGANOMETALLIC COPOLYMERS Progress Report
1988 8 p
(Contract DE-FG05-87ER-45306)
(DE88-006067; DOE/ER-45306/1) Avail: NTIS HC A02/MF A01

The work undertaken over the last 6 months involved the synthesis of some Si-C-N homopolymers/copolymers, solution characterization of same by NMR and FT-IR spectroscopy, elemental and thermogravimetric analyses, pyrolysis under N2 and NH3 and product/char characterization by FT-IR spectroscopy, and preliminary thermolysis-gas chromatography/mass spectrometry experiments on model systems and some thermolysates. One, or possibly two, scientific presentation(s) will be made on the preliminary results at the ACS National Meeting in Los Angeles, California. A full manuscript is also planned for preparation over the next few months. DOE

N88-21302# Sandia National Labs., Albuquerque, N. Mex.
INTERFACE STRUCTURE AND PROPERTIES OF ALUMINA/GLASS CERAMIC COMPOSITES
J. L. Keddie and T. A. Michalske Jan. 1988 42 p
(Contract DE-AC04-76DP-00789)
(DE88-006219; SAND-87-1884) Avail: NTIS HC A03/MF A01

Tough fiber-reinforced composites depend on fiber pull-out and crack bridging to arrest cracks in the matrix. In order to achieve fiber pull-out, there must be a weak interface between the matrix and the fiber. In this study, the interface formed at elevated temperatures between alumina and a zirconia-bearing glass-ceramic was characterized to determine its chemical and mechanical properties. The interface was analyzed in planar and cross-sectional specimens by SEM, TEM, optical microscopy, and X-ray diffraction. It was found that the diffusion of alumina into the glass-ceramic produces a dense layer of zirconia crystallization in the glass-ceramic within 20 microns of the alumina. The strength of the interface is inversely proportional to the thickness of this layer. Firing at longer times and higher temperatures produces the weakest interface. Activation energies (Q) and diffusion coefficients of aluminum into the glass matrix were calculated using a nonlinear regression analysis and data from ion microprobe profiles. Q was calculated to be 538 kJ/mol and the preexponential diffusion coefficient, D sub o, was found to be 4.96 x 10 to the 7th power sq cm/s. Some interfaces fractured spontaneously, possibly because of the martensitic transformation of zirconia. Although it is possible to achieve a weak interface, a weak interface demands long firing times (greater than three hours) or high

temperatures (greater than 1425 C). Under such rigorous conditions, a 20 micron diameter alumina fiber will totally dissolve. For this reason, the development of an in situ ZrO2 crystallization layer is not a suitable method to produce tough alumina fiber reinforced/glass ceramic composites. DOE

N88-21303*# National Aeronautics and Space Administration, Washington, D.C.
BURNING CHARACTERISTICS AND FLAMMABILITY OF PVC CABLES IN GROUPS
T. Mikado and K. Akita Apr. 1988 14 p Transl. into ENGLISH from Bulletin of Japanese Assn. of Fire Science and Engineering (Japan), v. 30, no. 2, 1980 p 75-80 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20226; NAS 1.77:20226) Avail: NTIS HC A03/MF A01 CSCL 11I

Because burning cables represent a danger of increasing secondary damage it is of utmost importance for disaster prevention to correctly evaluate the combustion characteristics of cable. However, in many cases cable is laid out in bundles complicating the combustion characteristics. A situation has developed where group cable characteristics are not completely understood. A new method is developed for testing the combustion of high polymer type cable and earlier reports gave comparative combustion measurement results. It was learned that there is considerable difference between the combustion characteristics of the grouped cables and those of single cables. This study is supplemental research concerning the special behavior of group PVC cables, throwing some light on their combustion characteristics. Author

N88-21304# Karlsruhe Univ. (West Germany). Inst. fuer Werkstoffkunde 2.
DEVELOPMENT, HIGH TEMPERATURE PROPERTIES, AND MICROANALYSIS OF NONOXIDE CERAMICS Final Report
Georg Grathwohl Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie May 1987 153 p In GERMAN; ENGLISH summary
(Contract BMFT-03-ZC-023)
(ETN-88-92103) Avail: NTIS HC A08/MF A01

Reaction bonded silicon nitride (RBSN) materials with additives (3.0 to 5.2 percent Y2O3) and (0.5 to 2.6 percent Al2O3) were postsintered, after optimization of the sintering process densities between 94 and 97 percent TD were reached. A three-step sintering process is found to be optimum by kinetic studies. The microstructures of the postsintered materials can be improved by using RBSN starting materials with smaller and uniformly distributed pores. Thus, density and properties can be further improved. Tensile creep tests, reverse cyclic bending in preliminary tests, and crack growth measurements were applied. Crack growth measurements were performed on various ceramics under static and cyclic loading. Creep, oxidation, and high temperature failure was studied for Si3N4 and SiC-materials. Temperature dependence of transient creep curves was determined. Critical temperature ranges were identified which occur in creep as in oxidation. Failure criteria for the Si3N4 and SiC-materials and the temperature limits for application were evaluated. By microanalytical methods the state and distribution of sintering additives and impurities in SiC-materials were evaluated; the state of the grain boundaries of two HIPSiC-materials was described. Microstructural changes due to the oxidation of Si3N4-materials were analyzed. ESA

N88-21305*# National Aeronautics and Space Administration, Washington, D.C.
PROCESSING, TEXTURE AND MECHANICAL PROPERTIES OF SINTERED SILICON CARBIDE
H. Landfermann and H. Hausner Apr. 1988 16 p Transl. into ENGLISH from Deutsche Keramische Gesellschaft, Fortschrittsberichte (Fed. Republic of Germany), v. 1, no. 1, 1985 p 25-31 Original language document was announced in IAA as A86-31705 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20253; NAS 1.77:20253) Avail: NTIS HC A03/MF A01 CSCL 11G

With regard to its favorable properties, in particular those shown at high temperatures, silicon carbide is of great interest for applications related to the construction of engines and turbines. Thus, silicon carbide could replace heat-resisting alloys with the objective to achieve a further increase in operational temperature. The present investigation is concerned with approaches which can provide silicon carbide material with suitable properties for the intended applications, taking into account the relations between characteristics of the raw material, material composition, sinter conditions, and results of the sintering process. The effects of density and texture formation on the mechanical properties are studied. It is found that a dense material with a fine-grained microstructure provides optimal mechanical properties, while any deviation from this ideal condition can lead to a considerable deterioration with respect to the material properties. Author

N88-21306*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHEMICAL VAPOR DEPOSITED SILICA COATINGS FOR SOLAR MIRROR PROTECTION
Daniel A. Gulino, Therese M. Dever, and William F. Banholzer (General Electric Co., Schenectady, N.Y.) Jan. 1988 9 p Presented at the 26th Aerospace Sciences Meeting, Reno, Nev., 11-14 Jan. 1988; sponsored by AIAA
(NASA-TM-100834; E-4023; NAS 1.15:100834; AIAA-88-0027)
Avail: NTIS HC A02/MF A01 CSCL 11C

A variety of techniques is available to apply protective coatings to oxidation susceptible spacecraft components, and each has associated advantages and disadvantages. Film applications by means of chemical vapor deposition (CVD) has the advantage of being able to be applied conformally to objects of irregular shape. For this reason, a study was made of the oxygen plasma durability of thin film (less than 5000 A) silicon dioxide coatings applied by CVD. In these experiments, such coatings were applied to silver mirrors, which are strongly subject to oxidation, and which are proposed for use on the space station solar dynamic power system. Results indicate that such coatings can provide adequate protection without affecting the reflectance of the mirror. Scanning electron micrographs indicated that oxidation of the silver layer did occur at stress crack locations, but this did not affect the measured solar reflectances. Oxidation of the silver did not proceed beyond the immediate location of the crack. Such stress cracks did not occur in thinner silica films, and hence such films would be desirable for this application. Author

N88-21307# Texas Technological Univ., Lubbock. Glass Research and Testing Lab.
DETERMINATION OF THE MODULUS OF ELASTICITY OF STRUCTURAL SILICONE SEALANTS Final Report
R. W. Rock, C. H. Chew, and J. E. Minor Dec. 1987 110 p
(Grant NSF ECE-86-00620)
(PB88-157458; TTU-IDR-84D) Avail: NTIS HC A06/MF A01 CSCL 11A

An increase in the use of structurally glazed window glass systems has resulted from recognition of the properties of silicone sealants. These sealants became known as structural silicone sealants through their use as structural connections. The sealant must have resistance to oxidation and ultraviolet rays since the seal may be in full exposure to sunlight. Further, it must not deteriorate when in contact with chemicals in the air or with water. A standard design methodology would be welcomed. Although manufacturers of structural silicone sealants provide material specifications for their products, not all of the required engineering properties can be obtained from these product data sheets. The modulus of elasticity (Young's modulus) is needed; the property is relatively unkown to most users of structural silicone sealants. Definition of the engineering property as functions of temperature, elongation rate, and percent elongation is the subject of the report. GRA

N88-21308# Lawrence Livermore National Lab., Calif.
ABRASION RESISTANT POROUS SILICA ANTIREFLECTIVE COATINGS
I. M. Thomas Dec. 1987 12 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-48)
(DE88-006230; UCRL-97223; CONF-880110-24) Avail: NTIS HC A03/MF A01

The abrasion resistance of a porous silica antireflective coating prepared from a colloidal silica suspension was increased by the addition of a soluble siloxane binder to the suspension prior to application. After evaporation of the solvent, this binder served to increase the adhesion between individual silica particles, thereby increasing the coating strength. The optimum binder concentration was 20 to 30% and at this level the optical properties and laser damage threshold of the original silica coating were retained. DOE

N88-21209# European Space Tribology Lab., Risley (England). Northern Research Labs.
THE PERFORMANCE OF THIN SOLID FILMS FOR SATELLITE GEARS
R. A. Rowntree and M. K. Vine *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 149-154 (For primary document see N88-21191 14-18)
(Contract ESTEC-5615/83-NL-PP)
Copyright Avail: NTIS HC A14/MF A01

N88-21274# Joint Publications Research Service, Arlington, Va.
A DENSE AND STRONG CERAMIC MATERIAL MADE FROM ZIRCONIUM DIOXIDE Abstract Only
Ye. S. Lukin, M. G. Sukhikh, and V. N. Moiseyenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 59 Transl. into ENGLISH from Steklo i Keramika (Moscow, USSR), no. 12, Dec. 1986 p 15-16 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21275# Joint Publications Research Service, Arlington, Va.
INCREASING THE RATE AT WHICH CERAMIC CASTINGS UNDERGO PRELIMINARY HEAT-TREATMENT IN AN ULTRA-HIGH FREQUENCY MAGNETIC FIELD Abstract Only
Ye. N. Prozorov and V. S. Glazachev *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 59-60 Transl. into ENGLISH from Steklo i Keramika (Moscow, USSR), no. 12, Dec. 1986 p 18-19 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21314# Joint Publications Research Service, Arlington, Va.
EFFECT OF PROTECTIVE COATINGS ON HIGH-TEMPERATURE FATIGUE OF HEAT-RESISTANT ALLOYS Abstract Only
Yu. G. Veksler, V. V. Gribov, V. P. Lesnikov, A. A. Rabinovich, G. F. Myalnitsa, and O. G. Zhiritskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 11 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 76-78 Original language document was announced in IAA as A87-17465 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21319# Joint Publications Research Service, Arlington, Va.
EFFECT OF OXIDATION ON STRENGTH AND THERMAL STABILITY OF MATERIAL BASED ON Si3N4 Abstract Only
V. A. Lavrenko, A. A. Chernovolenko, S. I. Sopenko, V. I. Zubov, A. F. Alekseyev, Yu. G. Gogotsi, A. B. Goncharuk, and V. V. Shvayko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 37-38 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 67-70 Original language document was announced in IAA as A87-17463 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21363# Joint Publications Research Service, Arlington, Va.
CONTEMPORARY CERAMICS AND THE NEW TECHNOLOGICAL REVOLUTION Abstract Only **c27**
Zhensu Pan *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 43 Transl. into ENGLISH from Wuli (Beijing, Peoples Republic of China), v. 16, no. 5, May 1987 p 265-270 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21486*# Swiss Center for Electronics and Microtechnology, Inc., Neuchatel.
TITANIUM CARBIDE COATINGS FOR AEROSPACE BALL BEARINGS
Hans J. Boving, Werner Haenni, and Hans-E. Hintermann *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 245-252 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 11C

N88-21504*# Ljubljana Univ. (Yugoslavia). Dept. of Mechanical Engineering.
PRESSURE INDUCED AGEING OF POLYMERS
I. Emri and W. G. Knauss (California Inst. of Tech., Pasadena.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 77-88 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11C

N88-21525*# Pratt and Whitney Aircraft, East Hartford, Conn.
A CONSTITUTIVE MODEL FOR AN OVERLAY COATING
D. M. Nissley and G. A. Swanson *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 419-436 (For primary document see N88-21498 14-39)
(Contract NAS3-23939)
Avail: NTIS HC A21/MF A01 CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-21309# Foersvarets Materialverk, Stockholm (Sweden).
ANALYSIS OF EXPLOSIVES. 1: COMPUTER PROGRAMS FOR PROCESSING OF X-RAY POWDER DEFFRACTION DATA
Anders G. Nord Nov. 1987 51 p
(PB88-156898; FOA-C-20685-2.3) Avail: NTIS HC A04/MF A01 CSCL 19A

Computer programs for flexible handling of X-ray powder diffraction data for explosives and other crystalline compounds were developed on an IBM-compatible PC. Powder data from various sources may be processed, and crystallographic unit cell dimensions for all symmetries can be refined. Theoretical powder patterns can be generated from any crystallographic cell. Use of the programs is exemplified. The FORTRAN 77 program listings are included as appendices. The programs are useful for solving many analytical-chemical problems. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

N88-21310# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (West Germany).
VIBRATION CHARACTERISTICS OF PUMPED FLUID SYSTEMS (VCPFS) Final Report
D. Eilers, G. Racca (Aeritalia S.p.A., Turin, Italy), M. Molzen, W. Klask, and F. Hopfgarten Paris, France ESA Nov. 1986 225 p
(Contract ESA-6094/84-NL-PB(SC))
(ESA-CR(P)-2499; ETN-88-91954) Avail: NTIS HC A10/MF A01

Vibration characteristics of pumped fluid systems were studied to determine possible disturbances of the microgravity environment on board a microgravity mission spacecraft, and to resolve the conflict of using active thermal control systems. Conventional freon and water cooling loops require improvement of vibrations generated on board, if specifications for microgravity limit acceleration levels. If vibration reduction is required, improvement of all of the fluid loop components is necessary due to the balanced contribution of individual sources. Many individual tools are available to avoid or reduce the vibrations generated, and which have to be applied in series and in parallel. No single tool is sufficient by itself. Secondary measures, like isolation of the pump package and fluid line, provide a significant degree of vibration reduction, but the effect is masked by the contribution of the other equipment. Two-phase flow thermal control loops offer advantages with regard to vibrations generated by small fluid flow rates and low power pump packages, but in the boiling and vapor phase a turbulent flow is expected inducing vibrational forces at the interfaces to the structure. ESA

N88-21223# University Coll. of North Wales, Bangor.
TOWARDS A PRACTICAL MICROGRAVITY ENVIRONMENT
A. R. Owens and D. I. Jones *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 245-250 (For primary document see N88-21191 14-18)
(Contract ESTEC-1755/85-Rider-1)
Copyright Avail: NTIS HC A14/MF A01

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-21311# Eidgenoessisches Flugzeugwerk, Emmen (Switzerland).
DEVELOPMENT OF AN ENGINEERING MODEL DYNAMIC COOLER Final Report
F. Berner, H. Oesch, K. Goetz, D. Parnitzki, and W. Haefliger Paris, France ESA Sep. 1987 137 p
(Contract ESTEC-5275/82-NL-PB(SC))
(F+W-TF-B-1885; ESA-CR(P)-2522; ETN-88-91963) Avail: NTIS HC A07/MF A01

A refrigeration system based on a vapor compression cycle, called a dynamic cooler was developed for space applications. The system was developed around a one-cylinder, reciprocating-action vapor compressor. Mass is 53.92 kg not counting the baseplate on which it must be mounted and the thermal blanket for the suppression of radiative heat exchange with the surroundings. When operated with Freon 502 as working fluid, the cooler can keep a thermally inert payload at 60 C below the temperature of the coolant to which it rejects the heat in the condenser. If the payload temperature is at the same level as the coolant temperature, the cooler can remove heat from the payload at a rate of 1 kW under steady-state conditions. Power consumption of the cooler at a nominal 28 V dc and maximum compressor speed of 1000 rpm ranges from slightly more than 100 W at the lowest achievable payload temperatures to twice this at cooling rates approaching 1 kW. ESA

N88-21312# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: MATERIALS SCIENCE Abstracts Only
10 Aug. 1987 95 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-87-007) Avail: NTIS HC A05/MF A01

Articles and reports from Soviet journals and books are translated and presented. The general topic of concern is Materials Science. Under that heading comes: Analysis, Testing; Coatings; Composite materials; Corrosion; Ferrous metals; Nonferrous metals, alloys, brazes, solders; Nonmetallic materials; Preparations; Treatments; Welding, Brazing, Soldering; and Extracting metallurgy, Mining. For individual titles, see N88-21313 through N88-21335.

N88-21313# Joint Publications Research Service, Arlington, Va.
EFFECT OF NONUNIFORM STATE OF THERMAL STRESS ON RESISTANCE OF EI826 ALLOY TO THERMAL FATIGUE Abstract Only c26
G. R. Semenov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 1 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 71-75 Original language document was announced in IAA as A87-17464 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The thermal fatigue behavior of a high temperature nickel base alloy in a high temperature gas flow is investigated experimentally using wedge shaped specimens. The extent to which the inhomogeneity of the thermal stressed state, in particular a temperature gradient, affects the thermal cycling fatigue life of the alloy is determined. E.R.

N88-21314# Joint Publications Research Service, Arlington, Va.
EFFECT OF PROTECTIVE COATINGS ON HIGH-TEMPERATURE FATIGUE OF HEAT-RESISTANT ALLOYS Abstract Only c27
Yu. G. Veksler, V. V. Gribov, V. P. Lesnikov, A. A. Rabinovich, G. F. Myalnitsa, and O. G. Zhiritskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 11 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 76-78 Original language document was announced in IAA as A87-17465 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The fatigue properties of EP539LM alloy with an Al-Nb-Si fused slurry coating and a Co-Cr-Al-Y electron beam coating are investigated experimentally in vacuum and in air at 900 C. It is found that the protective coatings reduce the fatigue life of the specimens both in vacuum and in air, with the electron beam coating affecting the fatigue life of the alloy to a lesser degree than the fused slurry coating. The negative effect of the coatings on the fatigue life of the alloy is attributed largely to the properties of the coating materials. E.R.

N88-21315# Joint Publications Research Service, Arlington, Va.
PHENOMENOLOGICAL PIERCING CHARACTERISTICS OF COMPOSITE MATERIALS Abstract Only c24
V. P. Muzychenko and V. I. Postnov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 15 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 62-66 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The piercing characteristics of several nonmetallic composite materials, as well as of 2 Ti alloys, are analyzed from the phenomenological standpoint on the basis of experimental data pertaining to barriers made of these materials subject to impact by high speed indenters. The composite materials tested include KSTE glass cloth, KST glass mats, KSVF glass fiber with fluorocarbon filler, and alternate layers of glass cloth and carbon tape with epoxy-triphenol binder. The data were processed so as

to reveal the functional dependence of critical indenter velocity, its entrance velocity and exit velocity, as well as the difference between them or the velocity drop, normalized to the critical velocity, on the product barrier thickness and barrier material density. Author

N88-21316# Joint Publications Research Service, Arlington, Va.
DEPENDENCE OF HYDROGEN EMBRITTLEMENT CF AUSTENITIC STAINLESS STEELS ON STRUCTURAL STATE OF GRAIN BOUNDARIES c26
P. A. Platonov, Yu. R. Kevorkyan, and I. Ye. Tursunov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 16-17 Transl. into ENGLISH from Fiziko-Khimicheskaya Mekhanika Materialov (Kiev, USSR), v. 22, no. 4, Jul. - Aug. 1986 p 23-26 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

An experimental study of hydrogen embrittlement of austenitic stainless steel was made for the purpose of determining its dependence on the structural state of grain boundaries. Tests were performed on flat specimens without any treatment and differing temperature and time treatment. Each treatment affects the grain boundaries differently. Reversibility of hydrogen embrittlement was found to be almost complete in raw specimens and only partial in annealed ones. This dependence of hydrogen embrittlement on the length of prior annealing treatment, its irreversibility increasing when specimens were annealed for a longer time period, is attributable to morphological changes at grain boundaries and particularly a buildup of carbides which precipitate during annealing and then act as hydrogen traps. Author

N88-21317# Joint Publications Research Service, Arlington, Va.
SOME STRUCTURAL ASPECTS OF CRACK PROPAGATION IN HEAT-RESISTANT STEELS UNDER CYCLIC THERMAL AND MECHANICAL LOAD Abstract Only c26
S. I. Tishayev, G. A. Kotelnikov, R. G. Miftakhov, and T. V. Tetyuyeva *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 26-27 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 13-17 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Two punch steels were tested for a study of crack propagation kinetics and irreversible structural changes under conditions of thermomechanical fatigue. Tests were performed on 2 mm thick strips 12 mm wide and 80 mm long, with a 0.1 mm deep stress concentrating 60 deg V notch on one surface. These strips were quenched and tempered and tested to ensure a tensile strength of 1700 to 1800 MPa. Microstructural and fractographical examination were done by optical and electron microscopy. The results reveal that in both steels the crack propagation kinetics and the fracture mode under conditions of thermomechanical fatigue correspond to irreversible structural changes within the thermal influence zone. Quenching and high temperature tempering were found to lower the cracking rate and raise the structural stability more than does lowering the temperature gradient during temperature cycling by modification of the alloy content or the geometrical design. Author

N88-21318# Joint Publications Research Service, Arlington, Va.
GROWTH OF FATIGUE CRACKS IN NICKEL ALLOYS AT HIGH TEMPERATURES Abstract Only c26
V. T. Troshchenko, A. Ya. Krasovskiy, V. N. Yezhov, I. V. Kramarenko, A. V. Prokopenko, and I. A. Makovetskaya *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 32 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 3-7 Original language document was announced in IAA as A87-17459 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Specimens of polycrystalline and single crystal nickel alloys were tested for cyclic fracture toughness in symmetric bending at 400 Hz at room and high (up to 1273 K) temperatures. It was found that high temperature reduces the threshold stress intensity factor and increases the crack growth rate in both alloys. The single crystal alloy has a higher fracture toughness than the polycrystalline alloy over the full temperature range studied. E.R.

N88-21319# Joint Publications Research Service, Arlington, Va.
EFFECT OF OXIDATION ON STRENGTH AND THERMAL STABILITY OF MATERIAL BASED ON Si3N4 Abstract Only c27
V. A. Lavrenko, A. A. Chernovolenko, S. I. Sopenko, V. I. Zubov, A. F. Alekseyev, Yu. G. Gogotsi, A. B. Goncharuk, and V. V. Shvayko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 37-38 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 8, Aug. 1986 p 67-70 Original language document was announced in IAA as A87-17463 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Results of a study of the effect of high temperature oxidation on the strength and thermal stability of a reaction sintered material based on Si3N4-SiC (70:30), are presented. It is shown that oxidation in the range of 800 to 1100 C decreases the room temperature strength of the material but has no effect on its strength at 1200 C. Oxidation at 1300 to 1350 C increases the strength of the ceramic at both 20 and 1200 C; a further increase in oxidation temperature again produces a decrease in strength. E.R.

N88-21320# Joint Publications Research Service, Arlington, Va.
ANISOTROPY OF LIGHT ABSORPTION BY COLOR CENTERS IN WAVEGUIDES PRODUCED ON PHOTOCHROMIC GLASSES BY DIFFUSION Abstract Only c74
L. B. Glebov, N. V. Nikonorov, G. T. Petrovskiy, and V. A. Tsekhomskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 38 Transl. into ENGLISH from Fizika i Khimiya Stekla (Leningrad, USSR), v. 12, no. 5, Sep. - Oct. 1986 p 549-554 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The anisotropy of light absorption by color centers in waveguides on photochromic glasses is analyzed for an explanation of its cause. Birefringence in photochromic glasses was first considered; a study was made with silver halide and copper halide glasses. Absorption of TE modes and TM modes was considered next; an experiment having been performed with light from a He-Ne laser circularly polarized for prevention of possible parasitic photoinduced dichroism. Further special experiments revealed that absorption anisotropy in the form of dichroism is caused neither by the specific waveguide geometry nor by orthogonality of activating and probing light beams, nor by preferential orientation of photosensitive microcrystals, but only by the photoelasticity effect under compressive stresses in the surface layer with a linear relation between the magnitudes of birefringence and dichroism. Color centers in photochromic glasses are evidently anisotropic. Author

N88-21321# Joint Publications Research Service, Arlington, Va.
DEPENDENCE OF FORMATION OF RADIATIVE COLOR CENTERS IN OPTICAL GLASS FIBERS ON TECHNOLOGICAL FACTORS Abstract Only c74
Ye. M. Dianov, V. N. Karpechev, N. S. Karpychev, L. S. Korniyenko, S. M. Mazavin, S. I. Miroshnichenko, A. O. Rybaltovskiy, and P. V. Chernov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 39 Transl. into ENGLISH from Fizika i Khimiya Stekla (Leningrad, USSR), v. 12, no. 5, Sep. - Oct. 1986 p 555-561 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Formation of radiative color centers absorbing visible and near infrared radiation in optical glass fibers was studied experimentally for the purpose of determining the dependence of their formation, as well as of their thermal and optical stability, on the fiber technology and particularly on the mode of core extrusion. Results indicate that optical glass fibers produced by VAD method have the highest radiation-optical stability, while those produced by the

MCVD method feature stronger induced absorption of infrared radiation and more intense absorption bands. Only in the spectra of fibers with a high OH-group concentration and of those dried in SOCl2 was there found an 0.8 micron induced absorption band. Author

N88-21322# Joint Publications Research Service, Arlington, Va.
MODELING GROWTH OF INTERDENDRITIC SILICON RIBBONS Abstract Only **c76**
M. Ya. Dashevskiy, B. N. Azarenok, and D. M. Kiselev *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 46 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Neorganicheskiye Materialy (Moscow, USSR), v. 22, no. 10, Oct. 1986 p 1589-1593 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The process of growing interdendritic silicon ribbons by the Czochralski method, for production of Si single crystals with specific surface profiles, is simulated mathematically with a system of two two-dimensional partial differential equations of heat conduction kinetics which describe the temperature distributions in the interdendritic region and in the dendrite frame as functions of time. The results reveal, for purpose of process control, that the transverse temperature distribution over both frame and ribbon crystallization fronts depends significantly on the depth of dendrite immersion and on the altitude of the ribbon crystallization front above the melt surface, as well as somewhat on the temperature of the thermal shield around dendrite frame above the melt surface, and negligibly on the temperature distribution in the melt. Author

N88-21323# Joint Publications Research Service, Arlington, Va.
OPTIMIZATION OF OXYGEN CUTTING PROCESS FOR TITANIUM ALLOYS Abstract Only **c37**
V. I. Trusov, V. V. Khilchevskiy, and A. Ye. Goldshteyn *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 65 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 9, Sep. 1986 p 3-4 Original language document was announced in IAA as A87-50026 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

A method is presented for constructing a mathematical model to describe the dependence of the cut width during the oxygen cutting of titanium alloys on the oxygen pressure and the travel speed of the cutting torch. The approach described here was implemented in a set of computer programs written in FORTRAN for optimizing the conditions of oxygen cutting. A graph of optimum oxygen cutting parameters is presented for VT22 titanium alloy. E.R.

N88-21324# Joint Publications Research Service, Arlington, Va.
EFFICIENCY OF FUSION DURING PERIODIC-PULSE LASER-BEAM WELDING Abstract Only **c37**
G. I. Levin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 66-67 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 9, Sep. 1986 p 9-10 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Welding of steel with a periodic pulse laser beam, generally with a CO2 or a solid state laser, is analyzed for the purpose of process optimization. There are four basic parameters of a periodic pulse heat source which independently govern the response of the target metal: average power and pulse power, pulse duration and pulse repetition rate. This provides four degrees of freedom for control, as compared with only one degree of freedom available (power) for control of a continuous wave laser. This advantage can be utilized for maximizing the efficiency of metal fusion, while also the mode of heat supply to the thermal interaction zone is optimized. Author

N88-21325# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF WELDS JOINING PARTS OF HIGH-STRENGTH PIPE STEELS AND PRODUCED BY BEAM OF CONTINUOUS-WAVE CO2-LASER Abstract Only **c37**
E. S. Lurye and I. A. Shmeleva *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 67 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 9, Sep. 1986 p 17-18 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

A study of welded joints between parts of high strength pipe steels for gas pipelines operating under up to 12 MPa pressure was made, such joints having been produced by a beam of 2.5 kW continuous wave CO2 laser and then tested mechanically by standard methods. Two steels were selected for testing, a ferritic-pearlitic one hardened by heat treatment and a bainitic one. Results indicate that welding pipe steels with a continuous wave CO2 laser produces better joints than manual electric-arc welding or automatic welding. Author

N88-21326# Joint Publications Research Service, Arlington, Va.
STRUCTURE AND PROPERTIES OF WELDED JOINTS PRODUCED BETWEEN NIOBIUM PARTS IN CONTROLLABLE HELIUM ATMOSPHERE Abstract Only **c26**
G. A. Petrunin, A. M. Lyubchik, N. F. Chugay, Ye. A. Asnis, and M. M. Nerodenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 69 Transl. into ENGLISH from Avtomaticheskaya Svarka (Kiev, USSR), no. 10, Oct. 1986 p 21-24 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Specimens of 1 mm thick niobium plates were joined by welding in a controllable helium atmosphere for a study of the impact strength of their joints. Differing welding rates were used. The joints were tested for microhardness and impact strength of the seam and the thermal influence zone with a PMT-3 hardness tester and with a swinging pendulum after two notches had been cut. A quantitative analysis of the dislocation structure and the stress-strain characteristics based on the data reveals an anomaly of niobium joints, namely an increase of impact strength with decreasing grain size. Accordingly, welding at a higher rate produces stronger joints. The thermal influence zone becomes susceptible to fracture as a result of strain hardening with attendant increase of the dislocation density during the welding process. Author

N88-21327# Joint Publications Research Service, Arlington, Va.
FRICTION WELDING: ADVANCED METHOD OF PRODUCING END CUTTING TOOL Abstract Only **c37**
V. A. Solovyev, G. P. Goloviznina, E. Kh. Arkhipova, and A. Ye. Korchemkin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 70-71 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 2-4 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The method of joining the bit and the shank of a point cutting tool by friction welding was introduced in the early nineteen sixties, the tool bit being made of wear-resistant heat-resistant high speed tool steel, and the shank being made of a strong and tough carbon or structural alloy steel. The method of friction welding was adopted in the 1970's, with the postwelding heat treatment modified. Isothermal annealing is more economical. Friction welding of cutting tools by this method reduces waste of material containing scarce metals and lowers the power requirements. Author

N88-21328# Joint Publications Research Service, Arlington, Va.
INERTIA WELDING WITH VARIABLE MAGNITUDE OF IMPACT LOAD Abstract Only **c37**
E. S. Karakozov, V. I. Kominov, V. I. Yegorov, and V. V. Levashov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 72 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 5-6 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

A machine for inertia welding is described which, in addition to an electromagnetic inertia drive for axial loading, also includes a pneumatic mechanism for axial impact loading. Design analysis

indicates that an electromagnetic inertia drive is simpler and more reliable than a hydraulic, pneumatic, or hydropneumatic one. Metallographic examination and hardness measurements indicate that pneumatic impact extends the range of welding capabilities and improves the quality of joints. Author

N88-21329# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF JOINT FORMATION DURING FRICTION WELDING OF TI ALLOYS TO Nb ALLOYS Abstract Only c26
I. M. Fedorenko, V. T. Bondar, B. D. Buts, and I. M. Yushchenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 72-73 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 6-7 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Friction welding of the OTi4 alloy to the WNi2N2E niobium alloy without shielding medium was studied for structural and phase transformation during joint formation. Metallographic examination of the seams by X-ray structural and phase analysis revealed a distinct and straight boundary. In addition to alpha-Ti and Nb forming under higher pressure and speed, with comminution of grains and recrystallization of the Ti alloy, an orthorhombic solid solution was also found to form under lower pressure and speed with resulting weakening of the joint. Author

N88-21330# Joint Publications Research Service, Arlington, Va.
OPTIMUM DURATION OF STEADY-STATE STAGE IN FRICTION WELDING OF METALS WITHOUT ARTIFICIAL BRAKING Abstract Only c37
A. S. Seregin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 73 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 7-9 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

An experimental study of friction welding of metals without artificial braking for instantaneous stopping of the machine was made, the advantages being saving of energy and elimination of impact. The optimum duration of the steady state stage, running at constant speed prior to disconnection of the electric drive motor from the power line and subsequent coasting to standstill, was determined in welding of St3 carbon steels to St3 carbon steel under a pressure of 64 MPa and R12 tool steel to St45 carbon steel under a pressure of 166 MPa. It was found that the constant speed stage should be of minimum duration and include the heating period only. Plastic deformation will then occur and a joint will form during the coasting stage. Author

N88-21331# Joint Publications Research Service, Arlington, Va.
ENSURING HIGHER STABILITY OF IMMERSED-ARC WELDING OF STRUCTURAL ALUMINUM ALLOYS AND MAGNESIUM ALLOYS Abstract Only c37
A. F. Nesterov, Ye. A. Bulgachev, and N. B. Boytsov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 75 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 13-14 Original language document was announced in IAA as A87-50029 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

Welding together 5 to 60 mm thick parts made of Al alloys or Mg alloys with a nonconsumable electrode and an immersed arc can be done in a single phase operation not requiring a filler rod, but requiring continuous maintenance of a constant arc voltage. This is achievable by vertical movement of the electrode or by regulation of the welding current depending on the magnitude and the sign of the difference between arc voltage and reference voltage. This welding technique produces high quality joints with very few defects. Author

N88-21332# Joint Publications Research Service, Arlington, Va.
THE TECHNICAL FEASIBILITY OF USING SPIKED-RADIATION LASERS TO CUT OUT AND WELD METALS Abstract Only c36
A. G. Grigoryants, A. I. Beiunik, A. B. Yeliseyev, I. N. Shiganov, and R. Sh. Zagidullin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 78 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 14-15 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

A one dimensional model for heat distribution in a semi-infinite body was used to calculate the process of heating a metal plate with a train of evenly spaced spiked laser radiation pulses. The effect of the integrated envelope of a spiked radiation pulse on the temperature field in the metal was also analyzed. It was established that heating metal with spiked pulses is more efficient than using constant intensity pulses. The use of spiked radiation pulses had a wide range of applications and can increase efficiency 25 to 30 percent. Author

N88-21333# Joint Publications Research Service, Arlington, Va.
DIFFUSION WELDING OF ALUMINOMAGNESIUM ALLOYS TO CERAMICS Abstract Only c37
V. A. Bachin, E. A. Goritskaya, I. Ye. Tikhonova, and K. E. Tsiolkovskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 79 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 17-19 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The formation and development of interaction loci during the diffusion welding of aluminomagnesium alloys and polycrystalline polycor and monocrystalline sapphire was studied. The tests were performed on ceramic plates polished and pickled with subsequent vacuum annealing. The ceramic plates were welded to aluminum foil, AMg6 foil, and MA2-1 alloy. Examination showed that, in the case of the polycors, interaction started primarily along grain boundaries and in porous areas. Higher concentrations of Mg were associated with more intensive interaction. Tests of the weld joints were performed on hollow cylinders to determine flexural strength. The strongest joints were achieved using AMg6 and relatively moderate welding conditions. Author

N88-21334# Joint Publications Research Service, Arlington, Va.
THE EFFECT OF SURFACE TENSION IN THE WELD POOL ON SEAM FORMATION WHEN WELDING THIN SHEET WITH LIGHT RAYS Abstract Only c37
S. A. Fedorov and V. V. Ovchinnikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 80-81 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 33-35 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The relationship between welding temperature, surface tension in the weld pool, and the final shape of the weld seam was studied. Various metals were welded on an experimental apparatus consisting of a xenon arc lamp and a close-focus ellipsoid reflector 300 mm in diameter made of aluminum alloy. The displacement of the metal in the weld bath was studied by tracking the motion of chromium oxide particles with high speed photography. Apparently, there is a direct relationship between the temperature of the weld pool, surface tension, the rate and direction of travel of the metal in the weld pool, and the final shape assumed by the weld seam. Author

N88-21335# Joint Publications Research Service, Arlington, Va.
THE USE OF PHOTOELASTIC METHODS TO STUDY THE STRESSED STATES OF SPOT-WELDED JOINTS Abstract Only c39
V. F. Kozhevnikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 81 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 38-40 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

The stressed states of full scale visual models of spot welded joints and of an actual spot welded specimen were studied and

compared to see whether a visual model can be utilized to analyze stress distribution in welded objects. A photoelastic coating used in the model was applied to one of the surfaces of the specimen. The tensile stress was applied to the faces of the specimen with non-eccentric force. The stress distribution data from the model and the specimen were then compared. It was found that visual models of spot welded objects can be successfully utilized to analyze the stressed states of actual spot welded objects.

Author

N88-21336# Royal Signals and Radar Establishment, Malvern (England).
IMPROVEMENTS IN END POINT DETECTION
A. B. Dean and M. Heath Apr. 1987 13 p
(RSRE-Memo-4035/A; BR103854; ETN-88-92048) Copyright
Avail: NTIS HC A03/MF A01

Ion beam milling using a broad angle ion source to profile and interconnect semiconductor device structures is described. By incorporating a comparatively low cost quadrapole mass spectrometer, accurate depth profiling of very small areas can be achieved by monitoring the secondary ions produced during the milling process. With the addition of the axial energy filter the resolution is greatly improved. More complex diagnostic investigations should be possible using broad beam ion beam milling techniques. Background signal levels are sufficiently low for a signal level of 80 counts/sec to be resolved. In order to achieve better resolution interface films of high secondary ion yields, which suffer little interference from the constituents of the ion source, quadrapole or vacuum chamber, are required. ESA

N88-21337# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
MODELLING OF A HYDRAULIC MOTOR AND SERVO-VALVE TO PRODUCE A DESIRED SYSTEM RESPONSE USING ANALOGUE AND DIGITAL COMPENSATION TECHNIQUES M.S. Thesis
S. Charnock 1987 196 p
(ETN-88-92079) Avail: NTIS HC A09/MF A01

A hydraulic system is analyzed, and its transfer function is derived. System specifications are outlined for position and velocity responses to step inputs. This leads to the design of an analog compensator to meet the desired system position performance specification. The analog compensator is tested on the actual hydraulic plant and on a 3rd order representation of the hydraulic plant. From the design of the analog compensator the system is redesigned using digital techniques and the comparable digital compensator found. This is tested on the actual hydraulic plant and on the analog model of the system. The differences between the two types of compensator are discussed. A control program for digital compensator implementation was written, and verified on the actual hydraulic plant and on the analog model of the system. ESA

N88-21338# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
2 Dec. 1987 122 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-042) Avail: NTIS HC A06/MF A01

Articles from Chinese journals and books are translated and presented. The areas of scientific and technological interest are: applied sciences; earth sciences; enviromental quality; life sciences; national developments; and physical sciences. For individual titles, see N88-21339 through N88-21349.

N88-21339# Joint Publications Research Service, Arlington, Va.
FINITE ELEMENT EXPLICIT ALGORITHM FOR SOLVING TEMPORAL TEMPERATURE FIELDS Abstract Only **c64**
Zhenzhong Huang *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 1 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 497-504 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

Practical calculations and numerical experiments show that in elements relating to a common node it is acceptable and reasonable for derivatives of temperature with respect to time on these nodes to be presented with one common node if the linear interpolation shape function is taken. The relationship between the derivative of temperature to time on a certain node and the temperature on other nodes around that node may therefore be established after discretization of the differential equation is made in space by the finite element method. Then an explicit scheme for calculating the temperature fields may be constructed. The algebraic equations obtained are simple and the procedure is straightforward, which are its two tangible advantages, and the calculating will, therefore, be fast. The stability analysis by the maximum principle, as in the example quoted, proves that the stability condition is similar to that in implicit algorithms. Author

N88-21340# Joint Publications Research Service, Arlington, Va.
METHOD FOR FINDING PRINCIPAL MODES OF NONLINEAR VIBRATION SYSTEMS AND THEIR STABILITIES Abstract Only **c39**
Liansheng Liu, Kelei Huang, and Quanzhong Huo *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 2 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 505-512 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

A new method is presented for finding the principal modes of nonlinear vibration systems by means of which the problem of finding principal modes of nonlinear systems is transferred to the problem of finding real roots of a set of algebraic equations. The method is applicable to various kinds of nonlinear vibration systems with many degrees of freedom, and is simple in calculation. Another new method is presented for analyzing the stabilities of principal modes of nonlinear systems. Author

N88-21341# Joint Publications Research Service, Arlington, Va.
FURTHER STUDY OF RELATION OF VON KARMAN EQUATION FOR ELASTIC LARGE DEFLECTION PROBLEM AND SCHRODINGER EQUATION FOR QUANTUM EIGENVALUES PROBLEM Abstract Only **c39**
Huichuan Shen *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 3 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqin, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 539-546 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The elastic large deflection problem is studied and previous work by the author is improved and continued. The von Karman equation is simplified for elastic large deflection problems, and it is turned into the nonlinear Schroedinger equation. The AKNS equation is expanded to a still more symmetrical degree under many dimensional conditions. Due to the connection between the nonlinear Schroedinger equation and the integratability condition for the AKNS equation or the Dirac equation, the exact solution is obtained for the elastic large deflection problem by the inverse scattering method. In other words, the elastic large deflection problem becomes wholly a quantum eigenvalues problem.

Author

N88-21342# Joint Publications Research Service, Arlington, Va.
ATMOSPHERIC ATTENUATION OF NEAR INFRARED RADIATION PROPAGATING THROUGH FOG Abstract Only **c47**
Zhengfang Song *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 17 Transl. into ENGLISH from Hongwai Yanjiu (Shanghai, Peoples Republic of China), v. 6A, no. 4, Aug. 1987 p 315-319 Original language document was announced in IAA as A88-10549 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The attenuation properties of the near IR radiation of GaAs LED propagating through fog are discussed. Comparisons of the attenuation coefficient with the simultaneously observed

meteorological visibility show that there is a close relationship between them. This conclusion is proved by the theoretical calculation. Author

N88-21343# Joint Publications Research Service, Arlington, Va.
PHYSICAL PROCESSES FOR MAINTAINING MEAN MERIDIONAL AND ZONAL CIRCULATION OF ATMOSPHERE IN MIDDLE LATITUDES, VOLUME 1 Abstract Only c46
Qiushi Chen *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 22 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 2, Jun 1987 p 167-175 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The maintenance of mean meridional and zonal circulation is discussed by a splitting method with which the dynamic equations are split into two parts: the forcing effects and the thermal wind adjustment process. The forcing effects, such as the large scale eddy fluxes, diabatic heating and friction, destroys the zonal thermal wind balance and the nonthermal wind can be returned to balance again in the adjustment process through the mean meridional circulation, from which the observed mean meridional cells are understood. It is found that the vector form of the mean meridional circulation is approximately equal to a vector M, which is a combination of some forcing terms. Therefore, the mean meridional circulation can be directly deduced from the observational results of M. Author

N88-21344# Joint Publications Research Service, Arlington, Va.
NUMERICAL SIMULATION OF GENERATION OF MESOSCALE CONVECTIVE SYSTEMS IN LARGE-SCALE ENVIRONMENT Abstract Only c46
Daqing Xia *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 23 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 2, Jun. 1987 p 185-194 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The generation of mesoscale convective systems is simulated by a seven level primitive equation model. The large scale part of the observed data at 1200 Z 11 June 1983, passing through a low pass filter, is taken as the initial data. The results show that the generation of mesoscale convective systems can be simulated from fields of meteorological variables on the large scale background. When the low level southwest jet stream is very moist, mesoscale convective systems can develop ahead of the wind speed maximum in the warm sector of the Changjiang-Huaihe River cyclone where the potential stability tends to remain negative. They are similar to the mesoscale convective complex (MCC), which appears frequently in the central part of the U.S. during the warm season (March to September), in the thermal structure, distribution of precipitation and process of generation and development. Author

N88-21345# Joint Publications Research Service, Arlington, Va.
PHYSICAL PROCESS FOR MAINTENANCE OF MEAN MERIDIONAL AND ZONAL CIRCULATION OF ATMOSPHERE IN MIDDLE LATITUDES, VOLUME 2 Abstract Only c46
Qiushi Chen *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 24 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 237-246 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The meridional eddy transfer of sensible heat is closely related to the transfer of the momentum in the large scale quasi-geostrophic motion. The large scale eddy transfers can be combined and then dissolved into two groups: a balanced transfer and an unbalanced transfer. The balanced transfer always causes the same value for the variations of the vertical shear of the mean zonal wind and the thermal wind in the temperature field. However, the unbalanced one always causes values with the same absolute magnitude, but with opposite signs for those variations. It is argued that the unbalanced transfer, with which the transfer of the meridional circulation must be associated, plays a very important role in the maintenance of the mean zonal circulation and the zone of the subtropical anticyclones in the winter in the Northern Hemisphere. The kinetic energy of the atmospheric motion is dissolved into a barotropic kinetic energy and a baroclinic kinetic energy, and the conversion processes of the energy are further discussed in detail. Author

N88-21346# Joint Publications Research Service, Arlington, Va.
NUMERICAL SIMULATION OF MEDIUM SCALE DISTURBANCE ON MEIYU FRONT Abstract Only c47
Kun Gao *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 25 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 289-296 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

Using a 10 level 90 km mesh mesoscale numerical model, a numerical simulation of a heavy rain during the meiyu season was made over the middle reaches of the Changjiang River. The model output is separated into synoptic and medium scale, with a selective filtering operator. The analysis lays emphasis on the characteristics of the medium scale disturbance linked with heavy rain and its synoptic scale environment. It is suggested that the development of the medium scale disturbance and accompanying precipitation is due to an instability of the gravity inertial waves under certain synoptic scale conditions. Author

N88-21347# Joint Publications Research Service, Arlington, Va.
STUDY OF PASSAGES OF CROSS-EQUATORIAL CURRENT DURING SOUTHERN MONSOON Abstract Only c47
Zengzhong Li *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 26 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 313-319 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

A preliminary study was made of the passages of the cross equatorial current at the lower and upper troposphere over the Indian Ocean and the northwest Pacific Ocean during the southern monsoon (from June to September). The grid wind and other data used occurred from 1974 to 1979. The average vertical velocity for every 5 days at 850, 700, 500, 300 and 200 hPa levels during June to August, 1979, was calculated by means of the continuity equation. It is obvious that there are two monsoon cells of latitudinal circulation. Author

N88-21348# Joint Publications Research Service, Arlington, Va.
INTERMITTENCY OF ATMOSPHERIC TURBULENCE-APPLICATION OF LYAPUNOV EXPONENTS AND FRACTIONAL DIMENSION Abstract Only c47
Qingqiu Shao *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 27 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 331-336 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

The atmospheric turbulence is highly nonuniform and intermittent. The characteristics of chaos are that positive characteristic exponents and fractional dimensions can quantitatively express the turbulent intermittency. The variation of Lyapunov exponents with parameters can quantify the development of the state of a nonlinear system. The value of the fractional dimension D indicates the degree of intermittency, and the smaller the value of D, the stronger the turbulent intermittency. The structure function law and energy spectrum law in homogeneous turbulence should be modified due to the intermittency. The intermittency also has powerful effects on the relative diffusion. Author

N88-21349# Joint Publications Research Service, Arlington, Va.
MATHEMATICAL STRESS ANALYSIS OF COMPOSITE MATERIALS c24
Shuangyin Zhang *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 100-115 Transl. into ENGLISH from Zhongguo Kexue (A Ji) (Beijing, Peoples Republic of China), no. 3, Mar. 1987 p 292-303 (For primary document see N88-21338

14-31)
Avail: NTIS HC A06/MF A01

The concept of nonuniform isoparametric element is introduced and the corresponding rigidity matrix is derived. As an application, the stress distribution at the end of a composite rope is calculated based on an axisymmetric nonuniform element method. Author

N88-21350# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
29 Oct. 1987 104 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-87-038) Avail: NTIS HC A06/MF A01

Articles are translated from USSR journals and books and presented. The areas of science and technology covered are: aerospace, applied sciences with emphasis on laser applications, earth sciences, life sciences, national developments, and physical sciences. For individual titles, see N88-21351 through N88-21364.

N88-21351# Joint Publications Research Service, Arlington, Va.
CHINA CONSTRUCTING HIGH-ALTITUDE TEST CELL c09
Daxiang Liu and Hanzhong Zhou *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 1-5 Transl. into ENGLISH from Guoji Hangkong (Beijing, Peoples Republic of China), no. 6, Jun. 1987 p 20-21, 56 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

A high altitude test cell is being constructed in China with continuous air supply. In an effort to develop China's aviation industry, considerable design and preparation work had been done before a decision was reached to begin construction. The tuning and testing equipment and system performance began in 1980; the results showed that design requirements were met. Initially, the test cell was used to conduct tests of direct engine exhaust into the atmosphere. In particular, the high altitude performance tests of a certain engine in a uniform flow field and its certification test in a distorted flow field were successfully completed. Now the second phase of the construction has begun, and the entire facility is expected to be completed and ready for service shortly. Author

N88-21352# Joint Publications Research Service, Arlington, Va.
WEIGHTED AVERAGING METHOD FOR IMAGE SMOOTHING REPORTED c64
Demin Wang and Qinglin Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 6-11 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 14, no. 6, Nov. 1986 p 85-90 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

A local weighted averaging method for image smoothing is presented. The weighting coefficients are simple continuous functions of the noise variance and the gray level difference between the center pixel in a 3x3 window and its neighbors. The method cleans noise effectively while preserving edge sharpness as well, and is computationally efficient. Tests show that the smoothing effect of this method is better than that of the reciprocal gradient weighted method. The results of applying this method to a real image are also given. Author

N88-21353# Joint Publications Research Service, Arlington, Va.
NEW WIDE-BAND TRANSDUCER DEVELOPED c33
Yiquan Yuan *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 12-19 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 14. no. 6, Nov. 1986 p 79-84 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

A new layered piezoelectric ring transmission transducer was developed. The wideband principle and structure design of the layered ring are analyzed. The properties of the device, such as low frequency, wide band and horizontal non-directivity, are given. The results can be applied to the design of layered underwater sound and ultrasonic projectors with cylindrical piezoelectric ceramic rings. Author

N88-21354# Joint Publications Research Service, Arlington, Va.
RADIAL TRACK OF MOVING OBJECTS DETERMINED BY HF BACKSCATTER TECHNIQUE c32
Junhu Du and Peinan Jiao *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 20-25 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Republic of China), v. 7, no. 3, Jul. 1987 p 229-233 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

A new method is proposed for solving the problem of high frequency back scattering; it is based on a previous paper by the author in which a method of calculating the ground distance of a fixed scattering source using only the minimum time delay curve and the signal time delay is presented. This method does not require midpoint ionospheric data. It uses the measured group path and Doppler frequencies of the moving source from a single station HF radar to calculate the ground distance of the moving target and determine its radial track. The measurements are taken at different times in the vicinity of the minimum time delay curve. A derivation of the method is presented, and an example is given where the calculated results are compared with experimental data to illustrate the validity of the method. Author

N88-21355# Joint Publications Research Service, Arlington, Va.
XeF EXCIMER LASER PUMPED BY HIGH-INTENSITY RELATIVISTIC ELECTRON BEAM c36
Chuangzhi Zhou, Xuhui Zhu, Pu Wang, Xiangdong Kang, Jiamin Yuan, and Ganchang Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 26-29 Transl. into ENGLISH from Yingyong Jiguang (Shanghi, Peoples Republic of China), v. 7, no. 3, Jun. 1987 p 97-98, 102 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

Preliminary experiments are presented with high intensity pulsed electron beam transverse pumped XeF excimer lasing. In a Ar:Xe:F2 = 97.2:2.5:0.3 gas mix with a total pressure of 2.5 atmospheres, 5.1 joule lasing output was obtained. Author

N88-21356# Joint Publications Research Service, Arlington, Va.
APPLICATIONS OF LASERS TO SEMICONDUCTOR STUDIES Abstract Only c36
Mingxin Qiu, Shizhen Lu, and Chenglu Lin *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 30 Transl. into ENGLISH from Wuli (Beijing, Peoples Republic of China), v. 16, no. 5, May 1987 p 275-279 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

With widespread applications in the semiconductor industry and an indispensable technology in very large scale integrated circuits, three areas of laser processing in semiconductor electronics are examined: (1) Laser micro trimming, scribing, and labeling; (2) Laser annealing and laser recrystallization of semiconductors, including adiabatic annealing, heat flow annealing, and isothermal or fast heat annealing; and (3) Laser chemical vapor deposition, photoetching, and doping, with attention to laser induction deposition of metals, compounds, and semiconductors; laser induction chemical photoetching, and laser induction doping and surface purification. Author

N88-21357# Joint Publications Research Service, Arlington, Va.
FOLDED LONG-PULSE XeCl EXCIMER LASER DESCRIBED c36
Hongru Cao, Yongrong Chen, Mingyu Che, and Xuejin Hu *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 31-35 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 5, May 1987 p 410-413 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

A novel dual channel discharge pumped excimer laser is reported. This laser uses a folded light path structure, a longer

lasing cavity (2m), as well as suitably lengthening the discharge time, obtaining 150 ns, 150 mJ laser output. Author

N88-21358# Joint Publications Research Service, Arlington, Va.
EFFECT OF ELECTRON BEAM DIVERGENCE ON THE GAIN OF FREE ELECTRON LASERS Abstract Only **c36**
Donghuan Zhao and Shizhan Lei *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 36 Transl. into ENGLISH from Hongwai Yanjiu (Shanghai, Peoples Republic of China), v. 6A, no. 2, Apr. 1987 p 119-124 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

The effect of divergence of an incident electron beam on the gain of free electron laser (FEL) is analyzed. In conditions in which laser gains can be realized, the relations between the maximum allowable divergence angle of incident electron beam and other physical parameters are discussed. On attaining lasing oscillations, in principle the allowable maximum divergence angle is attained on the condition that the laser gain should not be excessively lowered, or else lasing is not obtained. Electron beam divergence is shown by a diagram. Author

N88-21359# Joint Publications Research Service, Arlington, Va.
XeCl LASER-PUMPED NANOSECOND DYE LASERS Abstract Only **c36**
Shufen Fu, Zhangfen Qi, Honglie Fang, and Zhijiang Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 37 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 151-154 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

The experimental results are reported on generating nanosecond dye laser pulses by means of controlled resonator transients, using an XeCl excimer laser as the pumping source. Compared with N2 laser pumping, laser oscillations with shorter wavelengths and a higher threshold value system can be obtained with XeCl excimer laser pumping. The experimental arrangement, relations between pumping power and laser waveforms of PPO, R6G laser waveforms, and single spike output waveform of PTP and BPOB are diagrammed. Author

N88-21360# Joint Publications Research Service, Arlington, Va.
RESEARCH ON VARIABLE-PERIOD WIGGLER TYPE FREE ELECTRON LASERS Abstract Only **c36**
Keqi Qin, Jianwen Chen, Shizhan Lei, and Runwen Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 38 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 129-135 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

Using a new energy model, the gain equations of exponential gradient amplitude and the variable period wiggler free electron lasers (FEL) are obtained from the basis of the single particle model. The results show that FEL gain will increase when the amplitude and period of the magnetic field increase along the z-direction; however, the effect of the former (amplitude) is more apparent than the latter (period). Gain curve figures are shown of the wiggler field gain of the amplitude index gradient and space variable period. Author

N88-21361# Joint Publications Research Service, Arlington, Va.
A PICOSECOND TUNABLE ULTRASHORT CAVITY DYE LASER Abstract Only **c36**
Yixian Liu and Fuming Li *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 39 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 141-143, 146 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

The experimental arrangement and results of an ultrashort cavity Rh-B dye laser pumped by frequency-doubled pulses from a mode locked Nd phosphate glass laser are presented. The optimum operating conditions of the mode locked Nd phosphate glass laser were studied using hybrid TPF and OSA arrangement. A mode locked pulse train with a pulse duration of 5 picoseconds (ps) was obtained. Using this ps laser as the pumping source, an ultrashort cavity dye laser with tunable monomode pulses of less than 4 ps and wavelengths ranging from 620.1 to 641.6 nanometers (nm) was obtained. Author

N88-21362# Joint Publications Research Service, Arlington, Va.
FAILURE MECHANISM OF He-Ne LASERS Abstract Only **c36**
Zhongnan Luo, Jirong Yu, and Yuan Zhong *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 40 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 159-162 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

As proven by extensive experimentation, removal of operating gas and leakage of He are not the main causes affecting laser service life. Gas released from epoxide, especially when hydrogen is released, plays an important role in laser output. For an He-Ne laser operating normally, the partial pressure of hydrogen in the laser tube is very low; thus, its effect on laser output can be neglected. As to the failure of He-Ne laser, the decisive factor is the damage and contamination of the reflective membrane of the mirror; however, traces of hydrogen in the laser tube play a direct role during the discharge process on the mirror damage and contamination. Author

N88-21363# Joint Publications Research Service, Arlington, Va.
CONTEMPORARY CERAMICS AND THE NEW TECHNOLOGICAL REVOLUTION Abstract Only **c27**
Zhensu Pan *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 43 Transl. into ENGLISH from Wuli (Beijing, Peoples Republic of China), v. 16, no. 5, May 1987 p 265-270 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

The present state of research on structural ceramics and functional ceramics is reviewed, a summary is given of problems of application and development, and the close relationship between contemporary ceramics and the new technological revolution is clarified. High temperature structure ceramics have been used for internal combustion engines in the U.S. and Japan, and are being tested in China. The four major high temperature ceramic materials, Si3N4, SiC, extra malleable oxide ceramics, and fiber reinforced composite materials are discussed. In the area of functional ceramics applied in the electronics, information, and automation industries, three sorts of ceramic materials are introduced: base plate ceramic materials, the key material for integrated circuits; sensing materials; and piezoelectric ceramic materials. With continued increases in thermal efficiency and reductions in energy consumption, it is expected that applications of ceramics, especially as sensors, will increase tremendously. Author

N88-21364# Joint Publications Research Service, Arlington, Va.
NONLINEAR ACOUSTIC PARAMETER AND ITS APPLICATION IN ULTRASONIC IMAGING Abstract Only **c71**
Zuwen Qian *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 45 Transl. into ENGLISH from Yingyong Shengxue (Beijing, Peoples Republic of China), v. 6, no. 3, Jul. 1987 p 1-7 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

When sound waves of finite oscillation amplitude propagate in a medium, the waveform gradually distorts. This phenomenon is caused by the production of combination waves of higher order harmonics and other frequencies. The main content of nonlinear acoustics includes the description of the production, propagation, and reception of this kind of waves. The status and application prospects of nonlinear acoustic parameters are systematically described, especially the ultrasonic imaging used in medicine. Author

N88-21365# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
23 Nov. 1987 125 p Transl. into ENGLISH from various Chinese

articles
(JPRS-CST-87-041) Avail: NTIS HC A06/MF A01

Translated scientific and technological articles from Chinese journals and books are presented. The areas of concern are: Applied sciences; Earth sciences; Life sciences and National developments. For individual titles, see N88-21366 through N88-21373.

N88-21366# Joint Publications Research Service, Arlington, Va.
THEORETICAL STUDY OF COLLIDING PULSE MODE-LOCKING IN DYE LASERS **c36**
Jutao Chen, Yupu Liu, and Zhijiang Wang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 6-14 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Feb. 1987 p 65-69 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

A new theory is provided of colliding pulse mode locking of dye lasers which has a clear physical image and is able to better explain the properties of mode locked pulses, particularly in the area of frequency. The details of the interaction between the mode locking process are closely considered and, using self consistent field methods, the properties of colliding pulse mode locking were computed. The predicted results tallied with experiments. Author

N88-21367# Joint Publications Research Service, Arlington, Va.
PULSED MAGNET FIELDS FOR FREE-ELECTRON LASERS **c36**
Jiabiao Shi, Yinnian Pan, and Wei Wang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 15-18 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Feb. 1987 p 120-121 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

Developments of and experiments with pulsed free electron laser magnets are presented. The magnet can provide a 0 to 20 kG magnetic field with a very long lifetime. Experiments have shown that its field uniformity is 0.011 percent in an area of diameter 14 mm along the z axis from +400 to -400 mm (center point is 0). Author

N88-21368# Joint Publications Research Service, Arlington, Va.
PARTICLE SIMULATION RESEARCH BY PLASMA PARAMETRIC HEATING CAUSED BY STRONG LASER **c75**
Chenghai Liu, Jiatai Zhang, Shugui Zhang, Shuzhen Yu, Huaxiang Liang, and Linbao Xu *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 19-29 Transl. into ENGLISH from Jisuan Wuli (Beijing, People's Republic of China), v. 2, no. 4, Dec. 1985 p 454-461 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

A one and a half dimensional ion cloud method was used as a numerical simulation to study the parametric heating caused by the electric field of a strong laser with a frequency slightly higher than the plasma. The results show that the ion acoustic decay stability and oscillation two stream instability are stimulated simultaneously, the nonlinear saturation demonstrated rather fine structure, the plasma was severely heated, and, after saturation, the Langmuir turbulence spectrum followed a typical power law. Author

N88-21369# Joint Publications Research Service, Arlington, Va.
ANALYSIS, SUPPRESSION OF LAND CLUTTER CHARACTERISTICS REPORTED **c43**
Fengzhen Wang and Xinbo Zhang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 30-39 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 67; 98-103 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

The properties of land clutter and target echo of the ground combat surveillance radar are presented. The mathematical model for the clutter power spectrum and the relationship between the cutoff frequency of the clutter spectrum and the wind speed are obtained. Experimental results showed that strongly cluttered echoes from slow moving target could be detected by long time integration of positive and negative Doppler signals which were converted into positive and negative voltage, respectively. An investigation is also included of the statistical characteristics of the echo amplitude of the continuous wave radar. Author

N88-21370# Joint Publications Research Service, Arlington, Va.
SECONDARY ELECTRON EMISSION CHARACTERISTICS IMPROVED BY ION IMPLANTATION **c76**
Xianghuai Liu, Shichang Zou, and Yushan Tu *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 40-42 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 117-118 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

Chromium ion implantation is used to improve the oxidation resistance and the secondary electron emission characteristics of the copper grid in a television camera tube. Compared to the graphite evaporation technique, this method is superior and more practical. Author

N88-21371# Joint Publications Research Service, Arlington, Va.
METHOD FOR CHARACTERIZING END-PLATE SURFACE RESISTANCE OF DIELECTRIC RESONATOR **c33**
Deming Xu and Zhaonian Li *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 43-47 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 114-116 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

A novel method for characterizing the surface resistance of two conducting plates shortened at both ends of a dielectric resonator is given. It utilizes only one dielectric resonator that can resonate in both TE sub 012 and TE sub 021 mode at the same frequency. The theoretical relations and experimental results are also given. The described method, when compared to the dual resonator method, was proven to be convenient, relatively accurate and of practical usefulness. Author

N88-21372# Joint Publications Research Service, Arlington, Va.
FIRST REPORT ON InGaAs HALL DEVICE **c76**
Yiyang Zheng, Jinchang Zheng, Yanfang Liu, Shaojin Peng, Wenhong Lu, Guixian Shen, Yingzhu Zhang, Guixiang Su, and Kuiyou Jia *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 48-55 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 36-40 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

A Hall device is reported on which was prepared with InGaAs by planar technology. At the same carrier concentration, the sensitivity of InGaAs is 50 percent higher than that of a GaAs Hall device. Its energy consumption is low and its ohmic contact is good. It can operate in a wide temperature range (4 to 480 K or -50 to 200 C) because of its high carrier mobility and low temperature dependence characteristics. Although it has a narrower bandgap, it has a lower contact potential barrier. A 4 K, the device can operate in a strong magnetic field of up to 80 kG. The magnetic density of such a InGaAs Hall device was determined to be up to 80 kG at 4.2 K. Author

N88-21373# Joint Publications Research Service, Arlington, Va.
NUMERICAL MODELING OF DIVERGENT DETONATION WAVE **c34**
Zhiwei Li and Bangdi Liu *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 56-72 Transl. into ENGLISH from Jisuan Wuli (Beijing, People's Republic of China), v. 2, no. 1, Mar. 1985 p 55-66 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

The indefinite nature of divergent detonations under the assumption of instantaneous stable detonation is described. In

the numerical modeling method for divergent detonation, the artificial cohesiveness was improved and the Cochran reaction rate and the JWL equations of state were used to describe the ignition process of the explosion. Several typical divergent detonation problems were computed obtaining rather satisfying results. Author

N88-21374*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POWER COMPONENTS FOR THE SPACE STATION 20-kHz POWER DISTRIBUTION SYSTEM
David D. Renz 1988 10 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE
(NASA-TM-100866; E-4092; NAS 1.15:100866) Avail: NTIS HC A02/MF A01 CSCL 09C

Since 1984, NASA Lewis Research Center was developing high power, high frequency space power components as part of The Space Station Advanced Development program. The purpose of The Advanced Development program was to accelerate existing component programs to ensure their availability for use on the Space Station. These components include a rotary power transfer device, remote power controllers, remote bus isolators, high power semiconductor, a high power semiconductor package, high frequency-high power cable, high frequency-high power connectors, and high frequency-high power transformers. All the components were developed to the prototype level and will be installed in the Lewis Research Center Space Station power system test bed. Author

N88-21375*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTI-HUNDRED KILOWATT ROLL RING ASSEMBLY EVALUATION RESULTS
David D. Renz 1988 10 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE
(NASA-TM-100865; E-4091; NAS 1.15:100865) Avail: NTIS HC A02/MF A01 CSCL 13B

NASA Lewis Research Center has been evaluating low loss multi-hundred-kilowatt Roll Ring assemblies (an 8 circuit and a 4 circuit) for use on Space Station as the rotating joint power transfer device. In this device ac or dc power is transferred across the rotating joint through compressed rotating flexures. Results and conclusions of the evaluation program are presented. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-21376# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
GALILEI RELATIVITY PRINCIPLE IN CLASSICAL ELECTRODYNAMICS
G. A. Kotelnikov 1986 8 p In RUSSIAN
(DE87-703203; IAE-4275/1) Avail: NTIS (US Sales Only) HC A02/MF A01

A theorem is formulated that Galilei group is that of Maxwell equation exact symmetry group, providing the fields are transformed by nonlinear representation of this group. Galilei symmetry differs from the relativistic one in the fact that relativistic symmetry is manifested while postulating the light velocity invariance, whereas Galilei symmetry is manifested during postulating time invariance. In relativistic case the field transformations are linear and global, in Galilei case they are nonlinear and evidently depend on time and coordinates. Existence of Galilei symmetry for Maxwell equations means that in a certain sense, Galilei relativity principle holds not only in classical mechanics but in classical electrodynamics too. DOE

N88-21377# Stow Computer, Mass.
DIGITAL CORRELATOR FOR THE PORTABLE CHANNEL PROBER MEASUREMENT INSTRUMENT Final Report, Jan. - Dec. 1987
George E. Peo, Jr. 31 Dec. 1987 25 p
(Contract N00014-87-C-2018)
(AD-A189065) Avail: NTIS HC A03/MF A01 CSCL 20N

This document describes a Digital Correlator for the Portable Channel Prober Measurement Instrument being developed by the Naval Research Laboratory for use in experiments designed to characterize high frequency (HF) radio channels. This Digital Correlator is a digital signal processor designed and constructed by Stow Computer, 111 old Bolton Road, Stow, MA 01775, (617/508) 897-6838. Two Digital Correlators are integrated into the existing Digital Pre-processor to make a Portable Wideband HF Channel Analyzer. The Portable Wideband HF Channel Analyzer will be located at the receiving site of the channel probing experiment and is situated between the coherent radio receiver and the microcomputer used for data recording and analysis. The Portable Wideband HF Channel Analyzer computes the delay power spectrum of the received waveform. The in-phase and quadrature outputs of the receiver are sampled and converted to digital values by the Analog to Digital Converter, integrated by the Integrator, and correlated with a stored replica of the transmitted waveform by two Digital Correlators. The resulting tap gains are then read by the system microcomputer using the microcomputer interface. GRA

N88-21378# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
SPATIAL DISTRIBUTION OF TRAFFIC IN A CELLULAR MOBILE DATA NETWORK M.S. Thesis
J. P. M. G. Linnartz Feb. 1987 137 p
(EUT-87-E-168; ISBN-9-06-144168-4; ISSN-0167-9708;
ETN-88-91815) Avail: NTIS HC A07/MF A01

The use of integral transforms of the probability density function for the received power to analyze the relation between the spatial distributions of offered and throughout packet traffic in a mobile radio network with Rayleigh fading channels and ALOHA multiple access was assessed. A method to obtain the spatial distribution of throughput traffic from a prescribed spatial distribution of offered traffic is presented. Incoherent and coherent addition of interference signals is considered. The channel behavior for heavy traffic loads is studied. In both the incoherent and coherent case, the spatial distribution of offered traffic required to ensure a prescribed spatially uniform throughput is synthesized numerically. ESA

N88-21379# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
MULTIPLE-BEAM GROUND STATION REFLECTOR ANTENNA SYSTEM: A PRELIMINARY STUDY
P. Monnee and M. H. A. J. Herben Mar. 1987 30 p
(EUT-87-E-171; ISBN-9-06-144171-4; ISSN-0167-9708;
ETN-88-91818) Avail: NTIS HC A03/MF A01

As a wide-scanning multibeam reflector antenna, two systems were investigated. A bifocal antenna appears to be unsuitable for wide-angle scanning. A dual-reflector offset torus-antenna shows promising results. A possible application is examined: the simultaneous reception of signals from a number (n) of geostationary direct broadcast satellites with mutual distance of 6 deg. This antenna yields advantage when compared, in respect of the total required reflector area, with n separate antennas. ESA

N88-21380*# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
EXACT IMAGE METHOD FOR GAUSSIAN BEAM PROBLEMS INVOLVING A PLANAR INTERFACE
I. V. Lindell Mar. 1987 15 p Sponsored by NASA, Washington, D.C.
(Contracts N00014-83-K-0528; DAAG29-85-K-0079)
(NASA-CR-182702; NAS 1.26:182702; PB88-148804; Rept-13; ISBN-951-754-076-0) Avail: NTIS HC A03/MF A01 CSCL 20N

Exact image method, recently introduced for the solution of electromagnetic field problems involving sources above a planar interface or two homogeneous media, is shown to be valid also for sources located in complex space, which makes its application possible for Gaussian beam analysis. It is demonstrated that the Goos-Hanchen shift and the angular shift of a TE polarized beam are correctly given as asymptotic results by the exact reflection image theory. Also, the apparent image location giving the correct Gaussian beam transmitted through the interface is obtained as another asymptotic check. The present theory makes it possible to calculate the exact coupling from the Gaussian beam to the reflected and refracted beams, as well as to the surface wave.
Author

N88-21381# Fondazione Ugo Bordoni, Rome (Italy). Teletraffic Engineering Dept.
A PACKET-SWITCHED WIDE-AREA COMMUNICATION NETWORK SIMULATOR
Davide Grillo Sep. 1986 9 p Presented at the 2nd European Simulation Congress, Antwerp, Belgium, 9-12 Sep. 1986
(FUB-3-1986; ETN-88-91870) Avail: NTIS HC A02/MF A01

A simulator for analyzing the delay/throughput characteristic in models of wide-area communication networks employing packet switching technique is presented. Elements of the modelled networks are switching nodes and communication channels. Besides virtual circuit and window control, the simulator features piggybacked acknowledgement of multiple information frames; two-way information exchange with tunable intensity and unbalanced burstiness between the traffic streams; and centralized admission control into the transport network at both packet and session level. Voice/data integrated environment is also considered.
ESA

N88-21382# Gardner Research Co., Palo Alto, Calif.
ON-BOARD PROCESSING FOR MOBILE SATELLITE COMMUNICATIONS Final Report
Floyd M. Gardner Paris, France ESA 2 May 1985 222 p
(Contract ESTEC-5889/84-NL-GM)
(ESA-CR(P)-2519; ETN-88-91961) Avail: NTIS HC A10/MF A01

For mobile satellite communication networks, digital techniques to process all signals on-board the satellite (to separate signals, to demodulate them, to detect, synchronize and decode them, and to recombine them into efficient formats for retransmission) were studied. Frequency demultiplexing and modem operations problems are identified and avenues towards solutions are explored. It is shown that the frequency demultiplexer problem is dominant, in terms of the required computing burden and in the amount of knowledge yet to be gained.
ESA

N88-21383# Centre National d'Etudes Spatiales, Toulouse (France). Centre Spatial.
RADIO FREQUENCY COMPATIBILITY BETWEEN IRS AND SPOT 3: PRELIMINARY STUDY
M. Grondin 10 Jan. 1986 28 p
(CNES-86-CT/DRT/TIT/TR-011; ETN-88-92027) Avail: NTIS HC A03/MF A01

The RF compatibility between the Indian satellite IRS and SPOT 3 during launch and first orbits, with the hypothesis of a double launch on Ariane 4 was studied. Results are given in carrier-to-interference ratios for the TM and TC links. Concerning intersatellite compatibility, there can be a problem during the first orbit, when the intersatellite distance is only 2 m: the TC of each satellite is interfered with by the TM of the other satellite. Concerning satellites/Earth stations compatibility, there is no problem for the TM links and for the TC links.
ESA

N88-21384# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
CONTINUED DESIGN OF A POINTING, ACQUISITION, AND TRACKING (PAT) SUBSYSTEM FOR INTERSATELLITE LASER LINKS (ISL2) Final Report
Rudolf Kern and Udo Kugel Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany 31 Jul. 1987 86 p In GERMAN; ENGLISH summary
(Contract BMFT-01-TL-85068-ZK/RT)
(Teldix-15-093-178; ETN-88-92093) Avail: NTIS HC A05/MF A01

For intersatellite communication via laser links, Pointing, Acquisition and Tracking (PAT) subsystem development was initiated. The specifications were revised and the highly precise mechanism, as well as the associated drive and control electronics of the PAT subsystem were developed. Critical points were investigated with the aid of computer simulations. The replacement of the optical nutator assembly by the point ahead assembly was examined and seems to be promising. The development of hardware progressed to the extent that the integration of mechanisms and the tests can be carried out.
ESA

N88-21385 British Broadcasting Corp., Kingswood (England). Engineering Div.
DATACAST: THE TRANSMISSION SYSTEM
J. P. Chambers Mar. 1988 14 p
(BBC-RD-1988/1) Avail: Issuing Activity

The BBC Datacast service allows one-way transmission of general data services for public service data broadcasting or for commercial purposes using the existing teletext system as the carrier. Such uses were anticipated when the 1976 UK teletext specification was written, so Datacast can co-exist with the normal teletext service (Ceefax) without problems. This Report provides a detailed specification of the Datacast transmission standard.
Author

N88-21386# Foersvarets Materialverk, Stockholm (Sweden).
FREQUENCY BANDS AND ANTENNA TYPES FOR MARINE HF COMMUNICATIONS. RECOMMENDATIONS FOR COMMUNICATIONS SHIP-TO-SHORE, SHIP-TO-SHIP AND SHIP-TO-HELICOPTER BASED ON RADIOWAVE PROPAGATION CALCULATIONS
M. Broems Dec. 1987 77 p In SWEDISH; ENGLISH summary
(PB88-158035; FOA-C-30464-3.3) Avail: NTIS HC A05/MF A01 CSCL 17B

Recommendations for suitable frequency bands and demands on antennas are given for different kinds of communications. Calculations are made both for groundwaves and skywaves.
GRA

N88-21387# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
MILLIMETER-WAVE PROPERTIES OF THE ATMOSPHERE: LABORATORY STUDIES AND PROPAGATION MODELING
H. J. Liebe and D. H. Layton Oct. 1987 82 p
(PB88-164215; NTIA-87-224) Avail: NTIS HC A05/MF A01 CSCL 20N

Laboratory measurements were performed at 138 GHz of water vapor attenuation alpha x for pure vapor (H2O) and its mixtures with air, nitrogen (H2), oxygen (O2), and Argon (Ar). A computer-controlled resonance spectrometer was employed. The results are interpreted in terms of underlying absorption mechanisms. A substantial amount of the self-broadening terms proportional to the square of vapor pressure is left unaccounted. The negative temperature coefficient of the excess absorption is consistent with a dimer (H2O2) model. An empirical formulation

of the experimental findings is incorporated into the parametric propagation model MPM that utilizes a local (3ox H2), 48x O2) line base to address frequencies up to 1000 GHz. Details of MPM are given in two Appendices. Predictions of moist air attenuation and delay by means of the revised MPM program generally compare favorably with reported (10 to 430 GHz) data from both field and laboratory measurements. GRA

N88-21388# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
MILLIMETER-WAVE PULSE DISTORTION BY A SINGLE ADSORPTION LINE SIMULATING THE TERRESTRIAL ATMOSPHERE
G. Hufford Oct. 1987 44 p
(PB88-161237; NTIA-87-229) Avail: NTIS HC A03/MF A01 CSCL 20N

Molecular absorption lines in the millimeter-wave band make the atmosphere dispersive, thus causing the distortion of transmitted single shapes. To better understand how severe the distortion and what form it takes, it seems useful to examine the abstract problem of a single, isolated absorption line. The approximate response to such a line may be easily computed and is well described by only a few parameters. These parameters were evaluated and the distortion rather completely characterized for eight of the more prominent lines below 600 GHz. GRA

N88-21389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MONOLITHIC MICROWAVE INTEGRATED CIRCUIT TECHNOLOGY FOR ADVANCED SPACE COMMUNICATION
George E. Ponchak and Robert R. Romanofsky Apr. 1988 14 p
(NASA-TM-100829; E-3848; NAS 1.15:100829) Avail: NTIS HC A03/MF A01 CSCL 09C

Future Space Communications subsystems will utilize GaAs Monolithic Microwave Integrated Circuits (MMIC's) to reduce volume, weight, and cost and to enhance system reliability. Recent advances in GaAs MMIC technology have led to high-performance devices which show promise for insertion into these next generation systems. The status and development of a number of these devices operating from Ku through Ka band will be discussed along with anticipated potential applications. Author

N88-21390# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
A STUDY OF RADAR CROSS SECTION (RCS) CHARACTERISTICS AND THEIR APPLICATION IN FUTURE WEAPON SYSTEMS M.S. Thesis
W. A. McCluggage 1987 115 p
(ETN-88-92081) Avail: NTIS HC A06/MF A01

The sum of components technique was used to calculate the radar cross section (RCS) of a Canberra B2 aircraft. The theoretical result obtained by using simple shapes to model the aircraft were compared with practical results. It is found that this technique can be used to give a quick order of magnitude estimation of a target's RCS. However, the major drawback of this technique is that it cannot predict the rapid changes in RCS which result from a small change in aspect angle. Trends in radar guided weapons, the effects of aircraft shape on the overall RCS of a weapons platform, and reduction of aircraft RCS by appropriate shaping are discussed. Methods, including radar absorption, radar absorbing materials, impedance loading, and active cancellation, which can be used to reduce an aircraft's radar signature and the associated penalties are reviewed. ESA

N88-21391# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ELECTROMAGNETIC SHADOWING BY AN EXPONENTIALLY DISTRIBUTED ROUGH SURFACE M.S. Thesis
Clarence E. Reif Dec. 1987 89 p
(AD-A189677; AFIT/GE/ENG/87D-53) Avail: NTIS HC A05/MF A01 CSCL 20C

The purpose of this study was to develop a shadowing function for a rough surface model that was based upon an exponential probability density function (pdf). This study had four critical parts: (1) Derive the characteristic function and the joint slope probability density function for a second-order exponential pdf. (2) Write a computer program to numerically compute the shadowing function for the second-order exponential pdf surface model. (3) Compare the shadowing function obtained with an exponential like and Gaussian pdf. (4) Also, investigate a discrepancy in the mean-square total slope term. GRA

N88-21392# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ELECTROMAGNETIC SCATTERING BY AN EXPONENTIALLY DISTRIBUTED ROUGH SURFACE WITH THE INTRODUCTION OF A ROUGH SURFACE GENERATION TECHNIQUE M.S. Thesis
Thomas K. Roseman Dec. 1987 183 p
(AD-A189678; AFIT/GE/ENG/87D-55) Avail: NTIS HC A09/MF A01 CSCL 20C

The purpose of this investigation is to extend the capability of statistical modeling for the problem of electromagnetic scattering by random rough surfaces. A majority of prior studies considered the well known Gaussian joint probability density function (pdf), partly because of its mathematical convenience. About 25 years ago, a second pdf called exponential type was introduced and has since been used by several workers in the field. In this thesis it is shown that this exponential-type pdf fails to meet an essential statistical requirement. To remedy this situation, an exponential pdf that satisfies all the statistical requirements is derived. The scattering properties of surfaces modeled by this new exponential pdf are then formulated. In the second part of this thesis a user-oriented computer program is developed to create random surfaces whose statistical description is at the will of the user requiring only the input of a monovariate pdf. GRA

N88-21393# Naval Research Lab., Washington, D.C.
ON THE THEORY OF ELECTROMAGNETIC SCATTERING FROM A RAINDROP SPLASH
Lewis B. Wetzel 31 Dec. 1987 45 p
(AD-A188720) Avail: NTIS HC A03/MF A01

Electromagnetic scattering from a raindrop splash on a water surface is examined in terms of the splash structures that were disclosed by high-speed photography. Of the three basic scattering features, the crown, the stalk, and the ring wave, the first two are modeled as dielectric cylinders, while the third is treated by a perturbation approximation. Cross section predictions based on these models are found to be in good agreement with Hansen's laboratory measurements of splash scattering. Procedures are given for extending these models to natural rain falling on calm water surfaces, although the present lack of sufficiently complete experimental data prevents direct verification of the theory. Nevertheless, a few qualitative conclusions can be drawn from the formalism: the major scattering feature is the stalk, ans while the vertically polarized returns will have only a weak dependence on rain rate, the horizontally polarized returns will depend strongly on both the rain rate and the shape of the stalk (or drop) size distribution curves. Recognizing that comprehensive field measurments of splash scattering on calm water would be difficult to accumulate, several additional laboratory experiments are suggested. GRA

N88-21354# Joint Publications Research Service, Arlington, Va.
RADIAL TRACK OF MOVING OBJECTS DETERMINED BY HF BACKSCATTER TECHNIQUE
Junhu Du and Peinan Jiao *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 20-25 Transl. into ENGLISH from Kongjian Kexue Xuebao (Beijing, Peoples Republic of China), v. 7, no. 3, Jul. 1987 p 229-233 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21805# Bell Telephone Labs., Inc., Murray Hill, N. J.
GENERATING SQUEEZED MICROWAVE RADIATION WITH A JOSEPHSON PARAMETRIC AMPLIFIER
B. Yurke *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 476-488 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-21394# Worley Consultants Ltd., Auckland (New Zealand).
INDUSTRIAL ELECTRIC MOTORS AND CONTROLLERS Final Report
Jun. 1987 154 p Sponsored by New Zealand Energy Research and Development Committee, Auckland
(PB88-139589; NZERDC-145) Avail: NTIS HC A08/MF A01 CSCL 09A

The scope for energy savings to be made through the more efficient use of the electrical energy consumed by 400 volt, 3 phase asynchronous induction motors within New Zealand industry was determined. The energy performances of standard and high efficiency motors were examined together with the ranges of solid state controllers, and the part they can play in achieveing savings. It is concluded that there is considerable scope for energy savings to be made, and that the measures that may be taken to achieve these savings are economically viable. Finally, recommendations are made for implementation of an energy conservation program targeted at industrial motor users. GRA

N88-21395# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
HARMONIC AND RECTANGULAR PULSE REPRODUCTION THROUGH CURRENT TRANSFORMERS
Wang Jingshan Oct. 1986 34 p
(EUT-86-E-159; ISBN-9-06-144159-5; ISSN-0167-9708; ETN-88-91806) Avail: NTIS HC A03/MF A01

Current transformer (CT) measuring properties for harmonic reproduction and rectangular pulse reproduction were investigated. Results show that harmonics are reproduced through CT with less error than the fundamental frequency component when the secondary load is purely resistive. With an inductive secondary load, CT accuracy deteriorates as the frequency increases. A CT is saturated at higher voltage levels with harmonics than it is with the fundamental frequency. The secondary current distortion, when a CT is subjected to a series of rectangular pulses, is determined by the ratio of the pulse duration to CT time constant. The rectangular pulses caused by traveling wave reflections on a power transmission line can be reproduced through CT with negligible distortion due to the short pulse duration, the large CT time constant, and the negligible influence of the secondary winding to ground capacitance. The maximum pulse amplitude and duration permitted to avoid saturation were found. Analysis indicates that the rectangular pulses caused by traveling waves along the transmission line can be reproduced through the CT without saturation if maximum pulse amplitude is less than or equal to the maximum rms value of the ac current rated for CT accuracy. ESA

N88-21396# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
GADL: A GATE ARRAY DESCRIPTION LANGUAGE M.S. Thesis
P. E. R. Lippens and A. G. J. Slenter Jan. 1987 102 p
(EUT-87-E-165; ISBN-9-06-144165-X; ISSN-0167-9708; ETN-88-91812) Avail: NTIS HC A06/MF A01

A way to map digital networks onto gate array images is described. A language to describe gate array images, design rules for the wiring, and arbitrary specified macros from image dependent libraries is defined. A data base is generated by compiling the description of a gate array family in terms of the above items. Place and route software is automatically conditioned to implement arbitrary specifications of a digital system in terms of a netlist. The performance of the system is demonstrated for various practical situations. ESA

N88-21397# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Computer Science.
A NEW APPROACH ON TEST GENERATION FOR ARRAY STRUCTURES USING THE BEHAVIOR OF THE SYSTEM
Bert Molenkamp Aug. 1987 18 p
(INF-87-27; ETN-88-91828) Avail: NTIS HC A03/MF A01

A technique which uses circuit behavior for test generation and reduces the test generation time is described. It is assumed that in an array only one elementary block is faulty at a time and the fault is permanent. No assumption is made about an elementary building block. The circuit does not have to be modelled in a hardware description language, only a prototyping language is necessary for test generation. The technique is suitable for regular slanted array structures, and it seems, compared with other techniques, especially powerful if there are irregularities present, which are often on the border of a regular structure. ESA

N88-21398# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Electromechanics.
ANALYSIS OF INDUCTION MOTORS BASED ON THE NUMERICAL SOLUTION OF THE MAGNETIC FIELD AND CIRCUIT EQUATIONS Ph.D. Thesis
Antero Arkkio 1987 101 p Sponsored by the Academy of Finland and the Finnish Technology Foundation
(EI-59; ISBN-9-51-666250-1; ISSN-0001-6845; ETN-88-91876)
Avail: NTIS HC A06/MF A01

A method for the analysis of induction motors based on the combined solution of the magnetic field equations and the circuit equations of the windings is presented. The equations are discretized by the finite element method. The magnetic field is assumed to be two-dimensional. The three-dimensional features, i.e., the skew of the rotor slots and the end-region fields, are taken into account within the two-dimensional formulation. The general time-dependence of the field and the motion of the rotor are modelled correctly in a step-by-step solution. The amount of computation is reduced significantly if the time-dependence is assumed to be sinusoidal and phasor quantities are used in the solution. The method is applied to the calculation of a cage rotor motor and of a solid rotor motor. The sinusoidal approximation gives good results in the computation of steady-state locked-rotor quantities, but it does not model the motion of the rotor properly. The step-by-step method is used for computing machine quantities in steady and transient states. The operation of the solid rotor motor supplied by a static frequency converter is simulated. The results obtained by the method agree well with the measured ones. ESA

N88-21399# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
DESIGN, OPTIMIZATION AND CONSTRUCTION OF A dc-SQUID WITH COMPLETE FLUX TRANSFORMER CIRCUITS
J. Knuutila, M. Kajola, H. Seppae, R. Multikainen, and J. Salmi Oct. 1987 265 p Prepared in cooperation with Technical Research Centre of Finland, Espoo
(PB88-160742; TKK-F-A619; ISBN-951-754-280-1) Avail: NTIS HC A12/MF A01 CSCL 09A

The design of a complete dc Superconducting Quantum Interference Device (SQUID) with a flux transformer input circuit is described. The flux coupling circuits introduce a substantial capacitance across the SQUID and give rise to many resonances which may couple strongly to the SQUID dynamics. Both effects

lead to multiple modes in the SQUID dynamics and, consequently, to excess noise. For a low-noise SQUID with smooth characteristics, the analysis and practical considerations suggest signal coupling via an intermediary transformer. The method allows simultaneous optimization of the SQUID parameters, minimizing the parasitic capacitance, control over the resonances, and good inductance matching to practical magnetometer coils. A model is developed to optimize the structure; it describes the whole circuit with the help of a suitably modified autonomous SQUID, provided that the system is free from multiple modes due to resonances or large parasitic capacitance. Following these design principles, a dc SQUID was built. The fabrication of the SQUID and the high-quality electronics especially suitable for multiple-SQUID devices is presented. GRA

N88-21400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTICALLY INTERCONNECTED PHASED ARRAYS
Kul B. Bhasin and Richard R. Kunath 1988 9 p Presented at Advances in Semiconductors and Superconductors: Physics and Device Applications, Newport, Calif., 13-18 Mar. 1988; sponsored by the Society of Photo-Optical Instrumentation Engineers
(NASA-TM-100855; E-4058; NAS 1.15:100855) Avail: NTIS HC A02/MF A01 CSCL 09A

Phased-array antennas are required for many future NASA missions. They will provide agile electronic beam forming for communications and tracking in the range of 1 to 100 GHz. Such phased arrays are expected to use several hundred GaAs monolithic integrated circuits (MMICs) as transmitting and receiving elements. However, the interconnections of these elements by conventional coaxial cables and waveguides add weight, reduce flexibility, and increase electrical interference. Alternative interconnections based on optical fibers, optical processing, and holography are under evaluation as possible solutions. In this paper, the current status of these techniques is described. Since high-frequency optical components such as photodetectors, lasers, and modulators are key elements in these interconnections, their performance and limitations are discussed. Author

N88-21401# Rome Univ. (Italy). Dipt. di Fisica.
INDUCTIVE SPURIOUS COUPLING OF A dc-SQUID TO RESONANT INPUT CIRCUIT
M. G. Castellano (Consiglio Nazionale delle Ricerche, Frascati, Italy) and C. Cosmelli 20 Sep. 1987 18 p
(Nota-Interna-894; ETN-88-92250) Avail: NTIS HC A03/MF A01

The mutual inductance different from zero that exists in dc-SQUID between the feedback/modulation coil and the input coil is reviewed. This spurious coupling causes many effects when the input circuit of the SQUID is a high Q resonant circuit. In particular it affects the Q of the input circuit, decreasing it or making the system unstable. Measurements showing these effects were made on a dc-SQUID coupled to a gravitational radiation detector. A model to explain the spurious effects is presented and a comparison is made with the experimental measurements; the way to overcome unwanted effects modifying the feedback loop is also presented. ESA

N88-21402# Grenoble-1 Univ. (France). Techniques de llnformatique, des Mathematiques, de la Microelectronique et de la Microscopie Quant.
SHORTS IN SELF-CHECKING CIRCUITS
M. Nicolaidis Apr. 1987 30 p
(RR-657-I; ETN-88-92287) Avail: NTIS HC A03/MF A01

Consequences of shorts in self-checking NMOS and CMOS circuits are analyzed. Circuits checked by the parity code or by unordered codes are considered. Coverage of the different short types by techniques for other faults is examined. It is shown that the techniques cover feedback shorts having different consequences than the faults for which these techniques are originally proposed. Transfer of the results to other technologies is easy since the technology independent classification of short gives four possible cases: non feedback shorts always giving logical erroneous levels (the error on the two shorted lines is always single); non feedback shorts which may give indeterminate erroneous levels (the error on the two shorted lines may be double non unidirectional); even feedback shorts (the possible double error on the two shorted lines is implicitly unidirectional); and odd feedback shorts (the possible double error on the two shorted lines is implicitly non unidirectional). ESA

N88-21403# Grenoble-1 Univ. (France). Techniques de llnformatique, des Mathematiques, de la Microelectronique et de la Microscopie Quant.
ELECTRON BEAM SENSITIVE DEVICES FOR CONTROLLABILITY
Dominique Micollet Apr. 1987 43 p
(RR-658-I; ETN-88-92288) Avail: NTIS HC A03/MF A01

Electron beam testing of VLSI devices is introduced. The bases of electron beam controllability as to the physical phenomenon used: the electron beam induced current (EBIC), and integrated devices which allow the controllability are presented. The general laws of the EBIC are applied to the case of a diffused diode and show that the needed energies for controllability are greater than the observability ones. Microscope specifications are also given. The range of induced currents implies to integrate amplifiers to control the circuit : the general structure of these amplifiers is detailed, followed by the analysis of each part of them. Design methods and numerical results are presented. ESA

N88-21404*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN AUTOMATED OZONE PHOTOMETER
Joseph R. Lavelle Feb. 1988 11 p
(NASA-TM-100064; A-88079; NAS 1.15:100064) Avail: NTIS HC A03/MF A01 CSCL 09C

A photometer capable of automatically measuring ozone concentration data to very high resolution during scientific research flights in the Earth's atmosphere was developed at NASA Ames Research Center. This instrument was recently deployed to study the ozone hole over Antarctica. Ozone is detected by absorbing 253.7-nm radiation from an ultraviolet lamp which shines through the sample of air and impinges on a vacuum phototube. A lower output from the phototube indicates more ozone present in the air sample. The photometer employs a CMOS Z80 microprocessor with an STD bus system for experiment control, data collection, and storage. Data are collected and stored in nonvolatile memory for experiments lasting up to 8 hr. Data are downloaded to a portable ground-support computer and processed after the aircraft lands. An independent single-board computer in the STD bus also calculates ozone concentration in real time with less resolution than the CMOS Z80 system, and sends this value to a cockpit meter to aid the pilot in navigation. Author

N88-21215# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
RF-SWITCHES: APPLICATION AND DESIGN
W. Auer, E. Hettlage, and G. Ruff *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 191-195 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21231# European Space Tribology Lab., Risley (England).
SEPARABLE ELECTRICAL CONNECTORS FOR SPACE: A TRIBOLOGICAL AND ELECTRICAL ASSESSMENT
E. W. Roberts, J. D. Porteous, and N. Cable (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 303-309 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21353# Joint Publications Research Service, Arlington, Va.
NEW WIDE-BAND TRANSDUCER DEVELOPED

Yiquan Yuan *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 12-19 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 14. no. 6, Nov. 1986 p 79-84 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21371# Joint Publications Research Service, Arlington, Va.
METHOD FOR CHARACTERIZING END-PLATE SURFACE RESISTANCE OF DIELECTRIC RESONATOR
Deming Xu and Zhaonian Li *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 43-47 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 114-116 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-21405# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
STUDY ON THE BURNOUT WITH VARIATIONS OF FLOW TWISTING OVER TUBE LENGTH
R. S. Pometko and L. M. Gorban 1986 12 p In RUSSIAN
(DE87-703170; FEI-1804) Avail: NTIS (US Sales Only) HC A03/MF A01

Results of experimental investigation into regularities of heat transfer intensification in tubes with transition from untwisting flows to twisting ones and vice versa are given. Experiments were conducted on flowing freon-12 in a tube 10 mm in dia with two zones of independent heating at 1.06 MPa pressure, 500 to 3000 kg/m(2)s flow rate, 80 mm screw twisting pitch. Characteristic specific features of interaction processes of flow core with the screw and untwisting band. Main trends of changing critical heat flux in tubes with varied, in length, flow twisting are qualitatively explained. DOE

N88-21406# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
EXPERIMENTAL AND NUMERICAL STUDY OF LIQUID DISTRIBUTION IN DISPERSIVE-ANNULAR FLOW
V. M. Kashcheev, Yu. V. Muranov, R. V. Shumskij, Yu. Yu. Shtejn, and Yu. S. Yurev 1986 15 p In RUSSIAN
(DE88-700844; FEI-1818) Avail: NTIS (US Sales Only) HC A03/MF A01

Results of experimental and numerical investigation into liquid phase distribution in dispersive-annular flow at 6.86 MPa pressure, 500 to 1500 kg/m sup 2 x s flow rate and 0.4, 0.5 MW/m sup 2 specific heat flux are presented. It is ascertained that as the flow dispersive - annular regime is being developed, droplet concentration maximum is formed in the near wall zone of a channel. Its position and value depend on the regime parameters. Effects of diffusion, convection, mass sources on the distribution curve character is numerically studied. DOE

N88-21407# Hydrodynamics Applications, Inc., Carmel, Calif.
DISCRETE VORTEX ANALYSIS OF UNSTEADY FLOW ABOUT TWO-DIMENSIONAL CAMBERED PLATES
T. Sarpkaya 30 Oct. 1987 129 p
(Contract DE-AC04-76DP-00789)
(DE88-006597; SAND-87-7160) Avail: NTIS HC A07/MF A01

The evolution of a two-dimensional, incompressible, rapidly decelerating, time-dependent viscous flow about three cambered plates with included angles of 120, 180, and 240 degrees is simulated through the use of the discrete vortex model. Vorticity is represented by a distribution of discrete vortices. Each vortex is convected in the velocity field, calculated locally using the Biot-Savart law. The roll-up of the vortex sheets, the distribution of velocity and pressure on the cambers, and the drag force are calculated at suitable time intervals for a prescribed time-dependent flow. The results are compared with those obtained experimentally. DOE

N88-21408# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
AN EXPERIMENTAL-COMPUTATIONAL INVESTIGATION OF TRANSONIC SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTION IN A CURVED TEST SECTION
C. Nebbeling and B. Koren Jul. 1987 20 p Submitted for publication Sponsored in part by the Netherlands Foundation for the Technical Sciences
(CWI-NM-R8716; B8729647; ETN-88-91788) Copyright Avail: NTIS HC A03/MF A01

A transonic shock wave-turbulent boundary layer interaction was studied in a curved test section in which the flow was computed by a 2-D Euler flow method. The flow field near the shock wave at the convex wall corresponds to that near the shock wave at the upper surface of a transonic airfoil. The Mach number distributions from the Euler flow computations are compared to those obtained from holographic interferometry, at flow Mach numbers upstream of the shock wave of 1.15 and 1.37. At both Mach numbers the stream-line curvature leads to a supersonic region downstream of the shock wave. Relying on the Euler flow computations this must be attributed to viscous effects. Surface curvature and the adverse pressure gradient induce, compared to flat plate experiments without adverse pressure gradient, an increase of the boundary layer displacement thickness and of the shape factor. No increase of the separation length is measured with respect to experiments at noncurved surfaces. The separation criterion of ALBER et al. (1971) agrees with the present findings; this does not apply to the reattachment criterion. ESA

N88-21409# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
SOLUTIONS FOR DIRECT AND INDIRECT PROBLEMS IN FREE SURFACE FLOWS
C. Korving 1987 24 p
(Rept-87-35; B8721710; ISSN-0920-8577; ETN-88-91845)
Copyright Avail: NTIS HC A03/MF A01

The problem of a moving disturbance at a free surface is considered. The solution technique, based on the method of collocation, is developed from the formulation as a boundary value problem, as an alternative to starting from the representation in terms of surface singularity distributions. The intention is to solve the nonlinear problem at a finite domain of calculation in the neighborhood of the disturbance. In this respect, two problems are considered: the indirect problem, where the pressure at the free surface is known; and the direct problem, where a great part of the boundary is assumed to be known at and in the neighborhood of a partly submerged body. Since both versions could be alternatively used to solve the real problem of a partly submerged body, the direct and indirect problems are treated. ESA

N88-21410*# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
PROBLEMS IN FLUID DYNAMICS Final Report, 1 Jul. 1986 - 30 Apr. 1987
Lawrence Sirovich and Martin Maxey 27 Apr. 1988 6 p
(Grant NAG1-689)
(NASA-CR-182678; NAS 1.26:182678) Avail: NTIS HC A02/MF A01 CSCL 20D

A scheme was developed for the parametric differentiation and integration of gas dynamics equations. A numerical integration of the gas dynamics equations is necessarily performed for a specific set of parameter values. The linear variational equations are obtained by differentiating the exact equations with respect to each of the relevant parameters. The resulting matrix of flow quantities is referred to as the Jacobi matrix. The subsequent

procedure is then straightforward. The method was tested for two dimensional supersonic flow past an airfoil, with airfoil thickness, camber, and angle of attack varied. This approach has great potential value for rapidly assessing the effect of design changes. The other focus of the work was on problems in fluid stability, bifurcations, and turbulence. B.G.

N88-21411# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensgruppe Hubschrauber und Flugzeuge.

AN EXPLICIT METHOD FOR THE SOLUTION OF THE EULER EQUATIONS APPLIED TO UNSTEADY TWO-DIMENSIONAL FLOWS Thesis - Technische Univ., Brunswick, Fed. Republic of Germany [EINE EXPLIZITE METHODE ZUR LOESUNG DER EULERGLEICHUNGEN ANGEWANDT AUF INSTATIONAERE EBENE STROEMUNGEN]

R. Deslandes Jun. 1986 156 p In GERMAN

(MBB/LKE-121/S/PUB/257; ETN-88-91435) Copyright Avail: NTIS HC A08/MF A01

A method for the numerical solution of all types of unsteady flow phenomena, using the Euler equations was developed. The treated domain ranges from low subsonic (Mach number 0.1) to supersonic (Mach number 2.0), and also includes the transonic Mach number domain. The solution was obtained in two steps: the deduction of the general conservation form of the unsteady Euler equations for finite volumes, and the use of Explicit-Selective Elimination (ESE) to obtain the unsteady evolution of the solution. The use of ESE substantially reduces calculation time, without loss of accuracy. The fact that viscosity was not taken into account strongly limits the applicability of the method. ESA

N88-21412# Institut Franco-Allemand de Recherches, St. Louis (France).

CORRELATION AND SPECTRAL DENSITY MEASUREMENTS BY LDA

H. J. Pfeifer 28 Nov. 1986 22 p Presented at the 5th International Congress on Applications of Lasers and Electro-Optics, Arlington, Va., 10-13 Nov. 1986

(ISL-CO-244/86; ETN-88-92017) Avail: NTIS HC A03/MF A01

The state-of-the-art in correlation and spectral density measurements by means of laser Doppler anemometry (LDA) is reviewed. It is stressed that laser anemometry relies on the presence of particles in the flow serving as flow velocity indicators. This means that, except in heavily seeded flows, the instantaneous velocity can only be sampled at random instants. This calls for algorithms to estimate both correlation functions and power spectra. Possibilities to handle the problem of random sampling are described. It is shown that correlation methods and spectral density measurements with LDA produce information on flow characteristics which cannot be achieved by any other measuring procedure, particularly for the detection of coherent structures in flows of low turbulence and for spectra of velocity fluctuations in high temperature flows. ESA

N88-21413*# Old Dominion Univ., Norfolk, Va. Dept. of Chemical Sciences.

LOW PRESSURE GAS FLOW ANALYSIS THROUGH AN EFFUSIVE INLET USING MASS SPECTROMETRY Final Report, period ending 31 Dec. 1987

David R. Brown and Kenneth G. Brown May 1988 141 p

(Contract NAS1-17993)

(NASA-CR-182712; NAS 1.26:182712) Avail: NTIS HC A07/MF A01 CSCL 20D

A mass spectrometric method for analyzing flow past and through an effusive inlet designed for use on the tethered satellite and other entering vehicles is discussed. Source stream concentrations of species in a gaseous mixture are determined using a calibration of measured mass spectral intensities versus source stream pressure for standard gas mixtures and pure gases. Concentrations are shown to be accurate within experimental error. Theoretical explanations for observed mass discrimination effects as they relate to the various flow situations in the effusive inlet and the experimental apparatus are discussed. Author

N88-21414*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

WAVE INTERACTIONS IN A THREE-DIMENSIONAL ATTACHMENT LINE BOUNDARY LAYER Final Report

Philip Hall and Sharon O. MacKerrell Mar. 1988 35 p Submitted for publication

(Contract NAS1-18107)

(NASA-CR-181653; ICASE-88-22; NAS 1.26:181653) Avail: NTIS HC A03/MF A01 CSCL 20D

The 3-D boundary layer on a swept wing can support different types of hydrodynamic instability. Attention is focused on the so-called spanwise contamination problem, which occurs when the attachment line boundary layer on the leading edge becomes unstable to Tollmien-Schlichting waves. In order to gain insight into the interactions important in that problem, a simplified basic state is considered. This simplified flow corresponds to the swept attachment line boundary layer on an infinite flat plate. The basic flow here is an exact solution of the Navier-Stokes equations and its stability to 2-D waves propagating along the attachment can be considered exactly at finite Reynolds number. This has been done in the linear and weakly nonlinear regimes. The corresponding problem is studied for oblique waves and their interaction with 2-D waves is investigated. In fact, oblique modes cannot be described exactly at finite Reynolds number so it is necessary to make a high Reynolds number approximation and use triple deck theory. It is shown that there are two types of oblique wave which, if excited, cause the destabilization of the 2-D mode and the breakdown of the disturbed flow at a finite distance from the leading edge. First, a low frequency mode related to the viscous stationary crossflow mode is a possible cause of breakdown. Second, a class of oblique wave with frequency comparable with that of the 2-D mode is another cause of breakdown. It is shown that the relative importance of the modes depends on the distance from the attachment line. Author

N88-21415# Cranfield Inst. of Tech., Bedford (England). Dept. of Aerodynamics.

RANDOM-CHOICE BASED HYBRID METHODS FOR ONE AND TWO DIMENSIONAL GAS DYNAMICS

E. F. Toro Jan. 1988 28 p Presented at the 2nd International Conference on Hyperbolic Problems, Aachen, Fed. Republic of Germany, 14-18 Mar. 1988

(CAR-8801; ISBN-0-947767-82-7) Avail: NTIS HC A03/MF A01

Two hybrid methods applicable to the unsteady Euler equations in one or more space dimensions are presented. Each method consists of a smooth solver for smooth parts of the flow and the Random Choice Method for discontinuities. The solution of the Riemann problem (approximate or exact) gives sufficient information for switching between the smooth solver and RCM. In 1-D the hybrid methods give very accurate results throughout the flow field. Discontinuities are of zero width. In the multidimensional case shock waves are compromised, but contact discontinuities are still of zero width. Author

N88-21416# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.

MEAN FLOW STRUCTURE IN THE NEAR WAKE OF A TURBULENT JUNCTION VORTEX Final Report

F. J. Pierce, C. M. Kim, S. Nath, and J. Shin Dec. 1987 156 p

(Contract N00014-86-K-0036)

(PB88-150115; VPI-E-87-26) Avail: NTIS HC A08/MF A01 CSCL 20D

The mean flow structure in the near wake of turbulent junction or horseshow vortex is reported for an incompressible, subsonic flow. Measurements of the primitive variables of velocity and pressure are reported on all surfaces bounding a region of the wake of the vortex extending from the trailing edge of the body generating the vortex flow to one full chord length down stream. Measurements are also reported for a traverse plane through the

principal vortex structure. These data, together with those in the earlier report, VPI-E-87-6, document the junction vortex flow from well upstream of the separation region to the 200 percent chord position as measured from the body leading edge. GRA

N88-21417*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FINGERING FLOW PATTERNS OF THERMOSOLUTAL CONVECTION IN RECTANGULAR ENCLOSURES
L. W. Wang, J. J. Chen, and C. T. Chen (National Cheng Kung Univ., Tainan, Taiwan) 1988 14 p Proposed for presentation at the National Fluid Dynamics Congress, Cincinnati, Ohio, 24-28 Jul. 1988; sponsored by AIAA, ASME, ASCE, SIAM and APS
(NASA-TM-100854; E-4057; NAS 1.15:100854) Avail: NTIS HC A03/MF A01 CSCL 20D

Convection in rectangular enclosures with combined horizontal temperature and concentration gradients is studied. An electrochemical system is employed to impose the concentration gradients. Due to a large difference between the thermal and solutal diffusion rates the flow possesses double-diffusive characteristics. Very complex fingering flow patterns are observed around the two-phase interfaces. The main objective of the present work is to obtain more information on the flows near the two vertical phase interfaces under various parametric conditions. The fingering flows near the crystal could be one of the most important factors to cause the crystal imperfections. The ranges of the parameters studied are Sc (Schmidt number)=2200 to 2400, Pr (Prandtl number)=4.0 to 7.0, Gr sub T (Grashof number)=2.50 x 10 to the 6th to 5.10 x 10 to the 7th power, Ar (aspect ratio)=0.61 to 3.0, and N (buoyancy ratio)=0.05 to 54.8. Author

N88-21418# Lawrence Livermore National Lab., Calif.
OBSERVATION OF ANOMALOUS LOW J-VALUE STOKES AND ANTI-STOKES LINES IN STIMULATED ROTATIONAL RAMAN SCATTERING OVER LONG AIR PATHS
D. M. Pennington and M. A. Henesian 20 Nov. 1987 8 p Presented at the CLEO 88: OSA/IEEE Conference on Lasers and Electro-Optics, Anaheim, Calif., 25 Apr. 1988
(Contract W-7405-eng-48)
(DE88-003756; UCRL-97711; CONF-880402-3) Avail: NTIS HC A02/MF A01

Anomalous low-J-value Stokes and anti-Stokes lines in stimulated rotational Raman scattering are observed with large Fresnel number, linearly polarized beams. Forced light scattering at the rotational intermodulation frequency is also observed. Dynamics of the Stokes-anti-Stokes coupling will be discussed. DOE

N88-21419# Los Alamos National Lab., N. Mex.
THE TURBULENT HEAT FLUX IN LOW MACH NUMBER FLOWS WITH LARGE DENSITY VARIATIONS
P. J. ORourke and L. R. Collins 1988 19 p Presented at the Transport Processes in Dispersed Two-phase Flows With Applications to Propulsion Systems, Huntsville, Ala., 25 Feb. 1988
(Contract W-7405-eng-36)
(DE88-006445; LA-UR-88-633; CONF-880250-1) Avail: NTIS HC A03/MF A01

A transport equation has been derived which is the difference between the volume- and mass-averaged velocities and is simply related to the turbulent heat flux phi(sup h). Using this equation and an assumption analogous to the drift flux approximation of two-phase flow modeling, an algebraic closure relation for phi(sup h) that exhibits fluxes due to directed transport proportional to -del anti p and due to gradient transport proportional to -del tau has been obtained. Much work remains to be done before the model can be used in predictive calculations of low Mach number flows with large density variations. The transport equation involves an additional scalar b that is a measure of the density fluctuations. An equation for b must be derived and terms in it modeled. We hope to use the transport equation and b-equation in conjunction with a k - anti epsilon turbulence model. The k- and anti epsilon-equations must be reexamined to see that modifications are needed when the flows have large density variations. When mass transport is important, such as in many combustion problems, expressions for the turbulent mass flux must be developed. DOE

N88-21420# Texas Univ., Austin. Inst. for Fusion Studies.
INTERACTION OF A STRONG VORTEX WITH DECAYING TURBULENCE
P. W. Terry Jan. 1988 12 p
(Contract DE-FG05-80ET-53088)
(DE88-007102; DOE/ET-53088/306; IFSR-306) Avail: NTIS HC A03/MF A01

The evolution of a localized, axially symmetric vortex under the action of shear stresses associated with decaying two-dimensional turbulent vorticity which is inhomogeneous in the presence of the vortex is studied analytically. For a vortex which is sufficiently strong relative to the coefficient of turbulent eddy viscosity, it is shown that turbulent fluctuations in the vortex interior and diffusion of coherent vorticity by the turbulence localize to the vortex periphery. It is also found that the coefficient of diffusion is small compared to the coefficient of eddy viscosity. DOE

N88-21421*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HIGH-SPEED FLOW CALCULATIONS PAST 3-D CONFIGURATIONS BASED ON THE REYNOLDS AVERAGED NAVIER-STOKES EQUATIONS
Denny S. Chaussee Mar. 1988 12 p
(NASA-TM-100082; A-88118; NAS 1.15:100082) Avail: NTIS HC A03/MF A01 CSCL 20D

A computational fluid dynamics tool has been developed capable of analyzing the viscous supersonic/hypersonic flow about realistic configurations. This techniques can predict the flow in regions of canopies, wings, and canards in addition to the usual simple symmetric configurations. It also allows for interactions between aerodynamic surfaces such as the vortex interaction between canards and wings. Author

N88-21422*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POTENTIAL APPLICATIONS OF COMPUTATIONAL FLUID DYNAMICS TO BIOFLUID ANALYSIS
D. Kwak, J. L. C. Chang, S. E. Rogers (Sterling Federal Systems, Inc., Palo Alto, Calif.), and M. Rosenfeld Apr. 1988 17 p
(NASA-TM-100089; A-88126; NAS 1.15:100089) Avail: NTIS HC A03/MF A01 CSCL 20D

Computational fluid dynamics was developed to the stage where it has become an indispensable part of aerospace research and design. In view of advances made in aerospace applications, the computational approach can be used for biofluid mechanics research. Several flow simulation methods developed for aerospace problems are briefly discussed for potential applications to biofluids, especially to blood flow analysis. Author

N88-21423*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACCURACY REQUIREMENTS AND BENCHMARK EXPERIMENTS FOR CFD VALIDATION
Joseph G. Marvin May 1988 18 p
(NASA-TM-100087; A-88123; NAS 1.15:100087) Avail: NTIS HC A03/MF A01 CSCL 20D

The role of experiment in the development of Computation Fluid Dynamics (CFD) for aerodynamic flow prediction is discussed. The CFD verification is a concept that depends on closely coordinated planning between computational and experimental disciplines. Because code applications are becoming more complex and their potential for design more feasible, it no longer suffices to use experimental data from surface or integral measurements alone to provide the required verification. Flow physics and modeling, flow field, and boundary condition measurements are emerging as critical data. Four types of experiments are introduced and examples given that meet the challenge of validation: flow physics experiments; flow modeling experiments; calibration experiments; and verification experiments. Measurement and accuracy requirements for each of these differ and are discussed.

A comprehensive program of validation is described, some examples given, and it is concluded that the future prospects are encouraging. Author

N88-21424*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROHYDRODYNAMIC MIGRATION OF CHARGED DROPLETS IN AN INSULATING FLUID
R. Balasubramaniam and R. A. Wilkinson 1988 20 p Proposed for presentation at the National Fluid Dynamic Congress, Cincinnati, Ohio, 24-28 Jul. 1988; sponsored by AIAA
(NASA-TM-100849; E-4046; NAS 1.15:100849) Avail: NTIS HC A03/MF A01 CSCL 20D

The motion of charged, conducting droplets present in an insulating fluid medium is analyzed under the action of an electric field, in microgravity. Previous analyses of this problem have considered the Maxwell stresses as the only driving force. In the present study, arguments from macroscopic thermodynamics and the molecular theory of surface tension are used to show that the surface tension gradients can be induced due to the variation of the electric potential on the interface. In the limit of Reynolds numbers small compared to unity, the terminal velocity of migration of the droplet is calculated under the combined action of the Maxwell stresses and the surface tension gradients. The results show that there are no surface tension gradients (i.e., no electric potential variation at the interface) in a case that is due to the convection of the surface charges, surface tension gradients do exist and tend to reduce the terminal velocity of the droplet. The shape of the droplet altered by the motion was also calculated, when the deformations from the spherical shape are small. Author

N88-21132 Joint Publications Research Service, Arlington, Va.
INCOMPRESSIBLE THEORY OF INTERACTION BETWEEN MOVING BODIES AND VORTICITY FIELD: FORCE ON MOVING BODIES BY VORTICITY FIELD Abstract Only
Jiezhi Wu *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 30 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 22-30 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

N88-21135 Joint Publications Research Service, Arlington, Va.
RESEARCH ON FLOW AROUND BLUFF BODIES, FLOW INDUCED VIBRATIONS Abstract Only
Tianfeng Sun and Erjie Cui *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 33 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 62-75 (For primary document see N88-21130 14-02)
Copyright Avail: Issuing Activity

N88-21136 Joint Publications Research Service, Arlington, Va.
PROPAGATION OF ARTIFICIAL DISTURBANCES IMMERSED IN THICK TURBULENT BOUNDARY LAYER Abstract Only
Xiao Ming and H. U. Meier *In its* JPRS Report: Science and Technology. China 5 Jun. 1987 p 34 Transl. into ENGLISH from Kongqi Donglixue Xuebao (Mianyang, People's Republic of China), v. 5, no. 1, 1987 p 76-81 Original language document was announced in IAA as A87-37559 (For primary document see N88-21130 14-02)
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N88-21373# Joint Publications Research Service, Arlington, Va.
NUMERICAL MODELING OF DIVERGENT DETONATION WAVE
Zhiwei Li and Bangdi Liu *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 56-72 Transl. into ENGLISH from Jisuan Wuli (Beijing, People's Republic of China), v. 2, no. 1, Mar. 1985 p 55-66 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21492*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AMMONIA TRANSFER ACROSS ROTATING JOINTS IN SPACE
Mark H. Warner *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 341-353 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 20D

N88-21855# Centre National de la Recherche Scientifique, Meudon-Bellevue (France). Lab. d'Aerothermique.
PROBLEMS APPEARING AT INTERFACE BALANCES [PROBLEMES POSES PAR LES BILANS D'INTERFACE]
Roger Prudhomme *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 56-70 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

N88-21859# Institut de Mecanique des Fluides de Marseille (France).
HYDRODYNAMICAL REGIMES IN MOLTEN METALS UNDER A HORIZONTAL TEMPERATURE GRADIENT [REGIMES HYDRODYNAMIQUES DANS LES BAINS FONDUS METALLIQUES SOUMIS A UN GRADIENT DE TEMPERATURE HORIZONTAL]
Bernard Roux, Hamda BenHadid, and Patrice Laure (Nice Univ., France) *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 118-141 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-21425# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Messtechnik und Sensoren.
PRINCIPLES OF A LOW-COST LASER GYRO FOR ROTATING VEHICLES AND PLATFORMS
Ruediger Rodloff, Rudolf Neubauer, Wolfgang Burchardt, and Werner Jungbluth Jun. 1987 41 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1109)
(DFVLR-Mitt-87-15; ISSN-0176-7739; ETN-88-91918) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 16.50 Deutche marks

The construction principles for a low-cost laser gyro are outlined. During the development of this sensor everything was done to reduce the laser gyro to its basic elements, without adversely affecting the typical advantages of the gyro. It is demonstrated that a laser gyro without high-quality mirrors and without sophisticated stabilization circuits yields a gyroscope whose performance is comparable to that of a glass fiber gyro. ESA

N88-21426# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Systemtechnik und Navigation.
DESIGN, SIMULATION AND LABORATORY TESTING OF AN INERTIAL SYSTEM FOR MEASURING THE ATTITUDE AND NARROW-SPACED MOTIONS
Bernhard Stieller, Egmar Luebeck, and Volker Wetzig Nov. 1986 184 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1104)
(DFVLR-FB-87-42; ISSN-0171-1342; ETN-88-92111) Avail: NTIS HC A09/MF A01; DFVLR, VP-PL-DO, Postfach 90 60 58, 5000, Cologne, Fed. Republic of Germany, 62 Deutsche marks

A system for accurately measuring the attitude of an aircraft model under dynamic conditions in a wind tunnel was developed. Accuracy is within 0.03 deg using strapdown sensors of limited quality. The system also allows accurate measurement of fast narrow-spaced motions. Sensor errors are calibrated while the system is at rest, and their constant part is compensated during the measurement phase. ESA

N88-21427# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data and Information Service.
PRE-LAUNCH CALIBRATION OF CHANNELS 1 AND 2 OF THE ADVANCED VERY HIGH RESOLUTION RADIOMETER
C. R. N. Rao Oct. 1987 70 p
(PB88-157169; NOAA-TR-NESDIS-36) Avail: NTIS HC A04/MF A01 CSCL 14B

The basic physical principles underlying the prelaunch calibration of Channels 1 and 2 of the Advanced Very High Resolution Radiometer (AVHRR) are presented and discussed. The laboratory procedures for the calibration of the NASA 30-inch integrating sphere source and for the establishment of a simple linear regression relationship between the reflectance factor of the integrating sphere source and the AVHRR digital signals in Channels 1 and 2 corresponding to different levels of illumination (of the integrating sphere source) are described. GRA

N88-21428# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
FURTHER DEVELOPMENT OF A STELLAR CAMERA FOLLOWING THE ROTATION-MODULATION-COLLIMATOR PRINCIPLE FOR BALLOON-BORNE OBSERVATIONS IN THE X-RAY RANGE Thesis [WEITERENTWICKLUNG EINER STERNKAMERA NACH DEM PRINZIP DES RMK FUER DEN EINSATZ BEI BALLONGETRAGENEN BEOBACHTUNGEN IM ROENTGENBEREICH]
Peter Hammer Sep. 1987 98 p In GERMAN
(ETN-88-91496) Avail: NTIS HC A05/MF A01

An optical navigation instrument (the optical rotation-modulation collimator, RMC) for nocturnal scientific balloon-borne observations in the hard X-ray domain, in the range between 20 and 180 keV was developed. A laboratory model of the optical detector, including a photodiode and a signal amplifier, was built; its functioning and sensitivity for the stellar camera were tested. The improved version was integrated in the RMC system, and the stellar camera was connected to a real-time microprocessor evaluation system. The stellar camera was tested by point-source simulation in the laboratory and by imaging of a star. An optoelectronic test setup was built for the simulation of the optical RMC and the optimization of the detector. A high-precision solar test setup was developed. Measurements are presented. ESA

N88-21429 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
THE EFFECTS OF HUMIDITY ON THE PROFILE OF PHOTOGRAPHIC PLATES
C. Forno and A. Kearney Oct. 1987 46 p
(NPL-DMOM-88; ISSN-0309-3069; ETN-88-92075) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 OLW, United Kingdom

Quantitative measurements of out-of-plane displacement were examined, to provide a compensation which can be applied in situations involving photographic metrology measurements in unstable ambient conditions. Profile measurements by holographic methods and a mechanical transducer technique are discussed. It is shown that the effects of humidity on the out-of-plane displacement depend on the thickness of the supporting glass plate and exhibit an approximate inverse square relationship. Hysteresis effects are significant and depend on whether the emulsion is exposed to a wetting or drying cycle. Evidence suggests that for thick plates the emulsion is, at high levels of humidity, unable to resist the stresses in the glass which attempt to restore its initial profile, and a relaxation effect occurs. The only satisfactory method for preventing changes in profile may involve using a controlled humidity environment. ESA

N88-21430# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
CALIBRATION OF A HOT-WIRE/HOT-FILM ANEMOMETER OVER A RANGE OF TEMPERATURES, VELOCITIES AND PRESSURES M.S. Thesis
Denise C. Oka Sep. 1987 96 p
(AD-A189717; AFIT/GAE/AA/86D-12) Avail: NTIS HC A05/MF A01 CSCL 14B

An investigation was made of the possibility of developing a single calibration equation that would be applicable to a wide range of temperatures (68 F to 250 F), velocities (150 to 800 ft/sec), and pressures (15 to 33 psia). A platinum hot film, with a high enough operating temperature to provide good sensitivity to velocity, was calibrated at seven different temperature/pressure conditions. The data was used to calculate velocity, Reynolds number and Nusselt number, and a linear least squares curve fit was applied to the data as a function of Reynolds number raised to an exponent and as a function of Nusselt number times a load factor raised to an exponent. The exponents were chosen, through an iterative process, to provide the best agreement between the data and the curve fit equation. The results indicate that as the range of conditions is allowed to increase so does the error between measured velocity and velocity derived from the calibration equation. GRA

N88-21221# Societe Nationale Industrielle Aerospatiale, Cannes (France).
CRYOGENIC MECHANISM FOR ISO CAMERA
G. Luciano *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 233-236 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21495*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE SHUTTLE SOLID ROCKET MOTOR PROFILE MEASURING DEVICE (PMD)
John Redmon *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 387-399 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 14B

N88-21771# Joint Publications Research Service, Arlington, Va.
HOLOGRAPHIC DISK FOR DATA STORAGE Abstract Only
A. L. Mikaelyan, A. F. Vanin, E. Kh. Gulanyan, and S. A. Prokopenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 19-20 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 1074-1085 Original language document was announced in IAA as A88-10782 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21983# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IMAGE PROCESSING ON VEGA PICTURES
A. Abergel, J. L. Bertaux, and E. Dimarellis *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 689-694 Original contains color illustrations (For primary document see N88-21884 14-91)
Copyright Avail: NTIS HC A99/MF E03

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-21431*# KMS Fusion, Inc., Ann Arbor, Mich.
SOLAR GENERATION AND STORAGE OF O2 (a 1 DELTA g) Final Report, 12 Mar. 1985 - 12 Mar. 1987

Allen J. Twarowski, Phan Dao, and Lisa A. Good Washington NASA Mar. 1988 166 p
(Contract NAS1-17988)
(NASA-CR-4127; NAS 1.26:4127; KMSF-U1947) Avail: NTIS HC A08/MF A01 CSCL 20E

An investigation was performed of the technical steps required to design a solar powered oxygen-iodine laser. Singlet delta oxygen is formed upon transfer of energy from selected photoexcited dye molecules to ground state molecular oxygen and then is concentrated and stored as an endoperoxide by reaction with an aromatic hydrocarbon. The endoperoxide, when heated, releases singlet oxygen in high yield thus providing a regenerable source of laser fuel. Energy transfer from dye molecules to molecular oxygen was investigated. When dye molecules were adsorbed to polymer substrates it was observed that the dye became embedded in the polymer matrix. Porphin dyes were incorporated into films of 1,4-dimethyl-2-poly(vinylnaphthalene), 2PVN. An endoperoxide was formed when porphin-doped 2PVN was exposed to visible radiation. This demonstrates the possibility of generating singlet oxygen using solar energy and concentrating and storing it in one simple step. Transport of energy by exciton migration in polycrystalline dye films was also investigated. Author

N88-21432# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
LASER PULSE DETECTION WITH INFRARED RANGE SEMICONDUCTOR DETECTORS
V. G. Zhukovskij and V. A. Rtishchev 1986 20 p In RUSSIAN
(DE88-700857; IAE-4373/14) Avail: NTIS (US Sales Only) HC A03/MF A01

Method for registering short (approx. 150 ns), low power (approx. 10 sup -7 W), 10.6 (MU)m wave length pulses of radiation is investigated. Duration and power calibrated radiation pulses were formed by electrooptical modulator from the continuous CO2 laser radiation. Detecting system included cooled high ohmic, fast response photodetector Si:B and a charge sensitive amplifier. It is shown, that the minimum detectable radiation energy makes up approx. 3.10 sup -15 J. Comparison of pulse detection efficiency to the detection efficiency of pulse scattering on ruby laser radiation plasma shows, that the detection method described may be applied in diagnostics of multipulse Thomson scattering in CO2 laser for measuring the plasma electron temperature in tokamaks. DOE

N88-21433 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
A RUBIDIUM-STABILISED LASER DIODE FOR INTERFEROMETRY
G. P. Barwood, P. Gill, and W. R. C. Rowley Nov. 1987 45 p
(NPL-MOM-85; ISSN-0309-3069; ETN-88-91909) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

The optical properties of commercially-available index-guided laser diodes were investigated and their output frequencies stabilized by linear absorption to either of the 2 rubidium D lines at 780 nm and 795 nm. The reproducibility is estimated at better than 0.000001 of the optical frequency and the instantaneous linewidth at 5 mW power is 30 MHz with a peak-to-peak modulation depth of 100 MHz. Allan variance measurements on the beat between two Rb-stabilized lasers were made and the stability found to be 4 x 10 to the minus 10th power of the optical frequency at tau = 1 sec. The frequency of these lasers locked to the central Doppler-limited component of both D lines was measured by interferometry to + or - 0.0000001 of the optical frequency. ESA

N88-21434# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
X-RAY LASERS: STATE OF ART AND PROSPECT
Pierre Jaegle 1987 13 p Presented at the 14th International Conference on X-Ray and Inner Shell Processes, Paris, France, 14-18 Sep. 1987
(Contract DRET-85-1437)
(ETN-88-92003) Avail: NTIS HC A03/MF A01

It is shown that using hot plasmas for making soft X-rays amplifiers leads to laboratory sources brighter than any others by several orders of magnitude. Population inversions are produced either by collisional pumping due to plasma free electrons or by fast plasma cooling. Gain coefficients between 1 and 5 per cm are measured in the 60 to 200 A wavelength range. ESA

N88-21435# Technische Univ., Clausthal-Zellerfeld (West Germany). Inst. fuer Werkstoffkunde und Werkstofftechnik.
LASER SURFACE MELTING Final Report, Jan. 1984
Hans Wilhelm Bergmann and Barry L. Mordike Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie Oct. 1986 62 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany
(BMFT-FB-T-86-072; ISSN-0340-7608; ETN-88-92096) Avail: NTIS HC A04/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany, 13 deutsche marks + MWST

Laser applications to glazing are discussed. Unlike other methods of producing amorphous metals, laser surface melting offers the possibility of covering compact metals with an amorphous layer, which if the appropriate composition is chosen can provide excellent protection against corrosion. The thermal and kinetic principles of solidification were studied. Simulation programs enable correlations between the relevant parameters in rapid solution and those for laser control to be made. Based on these criteria different laser equipments were tested. Corrosion experiments were used to ascertain suitable compositions. Various techniques were developed and tested for coatings suitable for subsequent laser melting. Surface melting was carried out with various CO2 lasers. Considerable improvement is observed for melting with a Nd-YAG (Q switched) laser. ESA

N88-21436# National Academy of Engineering, Washington, D.C.
LASERS: INVENTION TO APPLICATION
J. H. Ausubel and H. D. Langford Aug. 1987 142 p
(PB88-161583; ISBN-0-209-03776-X; LC-87-042941) Avail: NTIS HC A07/MF A01 CSCL 20E

Topics addressed include: the laser (still young at 25); lasers in modern industry; lasers in communications and information processing; lasers in medicine; lasers in science; and interactions between the science and technology of lasers. A glossary is also included. GRA

N88-21437# Lawrence Livermore National Lab., Calif.
LASER-HETERODYNE INTERFEROMETRY WITH STREAK CAMERA DETECTION
M. Feldman, J. T. Salmon, and D. Mockler 1988 8 p Presented at the CLEO 88: OSA/IEEE Conference on Lasers and Electro-Optics, Anaheim, Calif., 25 Apr. 1988
(Contract W-7405-eng-48)
(DE88-003292; UCRL-97659; CONF-880402-6) Avail: NTIS HC A02/MF A01

The spatial interference pattern between a cw laser local oscillator and a pulsed laser (40 to 80 ns pulsewidth) is recorded by an electronic streak camera. Analysis yields time dependent wavefront and frequency chirp characteristics of single laser pulses. DOE

N88-21438# Lawrence Livermore National Lab., Calif.
DEMONSTRATION OF EFFICIENT FULL APERTURE TYPE 1/TYPE 2 THIRD HARMONIC CONVERSION ON NOVA
P. J. Wegner, M. A. Henesian, F. T. Marchi, and D. R. Speck 19 Nov. 1987 7 p Presented at the CLEO 88: OSA/IEEE Conference on Lasers and Electro-Optics, Anaheim, Calif., 25 Apr. 1988
(Contract W-7405-eng-48)
(DE88-003834; UCRL-97703; CONF-880402-4) Avail: NTIS HC A02/MF A01

Type 1/Type 2 third harmonic conversion was implemented at the 74 cm aperture of the Nova laser system. We discuss the performance capabilities and alignment issues of this scheme for Nova relative to conventional Type 2/Type 2 conversion. DOE

N88-21439# Lawrence Livermore National Lab., Calif.
SURFACE-EMITTING TWO-DIMENSIONAL LASER DIODE ARRAYS CONSTRUCTED ON ZIG-ZAG HEAT SINK SURFACE
S. K. Sheem Dec. 1987 10 p Presented at the CLEO 88: OSA/IEEE Conference on Lasers and Electro-optics, Anaheim, Calif., 25 Apr. 1988
(Contract W-7405-eng-48)
(DE88-005215; UCRL-97674; CONF-880402-7) Avail: NTIS HC A02/MF A01

A novel scheme is devised to construct two-dimensional surface-emitting laser diode arrays in which one-dimensional laser bars are mounted on a heat sink substrate having zig-zag surface contour. DOE

N88-21440# Lawrence Livermore National Lab., Calif.
EFFECT OF OFF-AXIS RADIATION IN AMPLIFIED SPONTANEOUS EMISSION
T. Wainwright Jan. 1988 13 p
(Contract W-7405-eng-48)
(DE88-007001; UCID-21299) Avail: NTIS HC A03/MF A01

Experiments involving amplified spontaneous emission in long, narrow structures are central to the development of x-ray laser schemes. The Fresnel number is quite large in the structures of interest so it is expected that diffraction effects will not be dominant, and consequently, ray tracing is commonly used in calculations of output intensity. If the laser has sufficiently high gain the intensity can reach the saturation level beyond which the individual rays no longer grow independently but compete with each other. The degree of saturation depends on the sum of all the ray intensities at any location so it is necessary to include all the ray directions which make appreciable contributions. Very simple results can be obtained if it is assumed that the rays that do not traverse the entire length of the lasing medium can be ignored. In this report we shall explore the consequences of that assumption. DOE

N88-21441# Zeiss (Carl), Oberkochen (West Germany).
LASER TECHNOLOGY: CO2 LASERS AND LASER OPTICS Final Report [LASERTECHNOLOGIE: CO2-LASER UND LASEROPTIK]
Dobler, Eisel, Friedrich, Gaenswein, Glueck, Peter Greve, Grosskopf, Hohberg, Neuroth, and Niederwald et al. Jan. 1987 104 p In GERMAN
(Contract BMFT-13-N-5314)
(ETN-88-91469) Avail: NTIS HC A06/MF A01

A laser for medical applications as well as laser-optical components were developed. A prototype of a compact, reliable CO2 laser of medium power (20 W CW) was developed, built, and tested. For high-power lasers in the 10.6 micron range, all essential components (lenses, mirrors, windows, and beam splitters) were developed, with specifications according to the state of the art. The preliminary testing of developed beam guidance systems was positive. A test laboratory for the testing of high-power IR laser optics under realistic conditions was built. ESA

N88-21442# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
PROGRESS IN X-RAY LASER EXPERIMENTS
Gerard Jamelot [1987] 8 p Presented at the Society of Photo-Optical Instrumentation of Optical Engineering (SPIE) 1986 Quebec International Symposium, Quebec, Canada Prepared in cooperation with Ecole Polytechnique, Palaiseau (France)
(ETN-88-92004) Avail: NTIS HC A02/MF A01

Research devoted to the achievement of a lasing action in the soft X-ray wavelength range is presented. General problems of laser produced plasmas considered as amplifying media are described. The question of superradiance and of resonators for X-rays is considered. The most important mechanisms proposed to produce population inversions for XUV and experimental results are described. ESA

N88-21443# Paris-Sud Univ., Orsay (France). Lab. de Spectroscopie Atomique et Ionique.
REVIEW OF X-RAY LASER STUDIES AT THE GRECO: LASER-MATTER INTERACTION
G. Jamelot, P. Jaegle, A. Carillon, F. Gadi, B. Gauthe, H. Guennou, A. Klisnick, C. Moller, and A. Sureau 1987 10 p Presented at the Intl. Symposium on Short Wavelength Lasers and their Applications, Osaka, Japan, 11-13 Nov. 1987 Submitted for publication
(Contract DRET-85-186)
(ETN-88-92005) Avail: NTIS HC A02/MF A01

It is shown that laser-plasma recombination produces population inversions between the 5f and 3d levels of Li-like ions. Inversions occur a few nanosec after the end of plasma heating by the laser light, when the plasma is expanding and cooling. In aluminum, it leads to an amplification at 105.7 A, with a gain-length product of 2 to 2.5. It is planned to increase this value by a factor 5 by producing longer plasma columns. Extended facilities make it possible to bring together 5 laser beams in a linear focal spot of 6 cm length, in keeping the flux density at the same level as in the present experiment. Another line of research is the isoelectronic scaling of the Li-like recombination scheme to shorter wavelength lasing. Studies show that large gains may be expected in the water window, making it possible to study living biological samples. An experiment on sulfur gives a gain-length product of 1.5 to 2 at 65.2 A. Shorter wavelengths call for enhancement of the flux density on the target surface. ESA

N88-21444# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CALCULATION OF THE EFFICIENCY OF A RESONANT CYCLOTRONIC ELECTRON MASER (GYROTRONS) [CALCULO DA EFICIENCIA DE MASERS DE RESSONANCIA CICLOTRONICA DE ELETRONS (GIROTRONS)]
J. J. BarrosodeCastro and A. Montes Sep. 1987 12 p In PORTUGESE Presented at the 2nd Interchange Seminar between the Institutes INPE-CNPq, Sao Jose dos Campos, Brazil, Dec. 1982
(INPE-4387-PRE/1207) Avail: NTIS HC A03/MF A01

The relativistic equation which describes the motion of electrons, with bunching in the annular section, in the electromagnetic field of a cylindrical waveguide which operates in the TE sub 021 mode, is numerically resolved. By calculating the electron energy in the long cavity, the process of energy exchange between the bunch and the RF fields was investigated. It was verified by energy extracted from the electromagnetic field of the cavity resonator demonstrating the transverse energy of electron rotation. Author

N88-21332# Joint Publications Research Service, Arlington, Va.
THE TECHNICAL FEASIBILITY OF USING SPIKED-RADIATION LASERS TO CUT OUT AND WELD METALS Abstract Only
A. G. Grigoryants, A. I. Belunik, A. B. Yeliseyev, I. N. Shiganov, and R. Sh. Zagidullin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 78 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 14-15 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21355# Joint Publications Research Service, Arlington, Va.
XeF EXCIMER LASER PUMPED BY HIGH-INTENSITY RELATIVISTIC ELECTRON BEAM
Chuangzhi Zhou, Xuhui Zhu, Pu Wang, Xiangdong Kang, Jiamin Yuan, and Ganchang Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 26-29 Transl. into ENGLISH from Yingyong Jiguang (Shanghi, Peoples Republic of China), v. 7, no. 3, Jun. 1987 p 97-98, 102 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21356# Joint Publications Research Service, Arlington, Va.
APPLICATIONS OF LASERS TO SEMICONDUCTOR STUDIES Abstract Only
Mingxin Qiu, Shizhen Lu, and Chenglu Lin *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 30 Transl. into ENGLISH from Wuli (Beijing, Peoples Republic of China), v. 16, no. 5, May 1987 p 275-279 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21357# Joint Publications Research Service, Arlington, Va.
FOLDED LONG-PULSE XeCl EXCIMER LASER DESCRIBED
Hongru Cao, Yongrong Chen, Mingyu Che, and Xuejin Hu *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 31-35 Transl. into ENGLISH from Guangxue Xuebao (Shanghai, Peoples Republic of China), v. 7, no. 5, May 1987 p 410-413 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21358# Joint Publications Research Service, Arlington, Va.
EFFECT OF ELECTRON BEAM DIVERGENCE ON THE GAIN OF FREE ELECTRON LASERS Abstract Only
Donghuan Zhao and Shizhan Lei *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 36 Transl. into ENGLISH from Hongwai Yanjiu (Shanghai, Peoples Republic of China), v. 6A, no. 2, Apr. 1987 p 119-124 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21359# Joint Publications Research Service, Arlington, Va.
XeCl LASER-PUMPED NANOSECOND DYE LASERS Abstract Only
Shufen Fu, Zhangfen Qi, Honglie Fang, and Zhijiang Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 37 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 151-154 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21360# Joint Publications Research Service, Arlington, Va.
RESEARCH ON VARIABLE-PERIOD WIGGLER TYPE FREE ELECTRON LASERS Abstract Only
Keqi Qin, Jianwen Chen, Shizhan Lei, and Runwen Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 38 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 129-135 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21361# Joint Publications Research Service, Arlington, Va.
A PICOSECOND TUNABLE ULTRASHORT CAVITY DYE LASER Abstract Only
Yixian Liu and Fuming Li *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 39 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 141-143, 146 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21362# Joint Publications Research Service, Arlington, Va.
FAILURE MECHANISM OF He-Ne LASERS Abstract Only
Zhongnan Luo, Jirong Yu, and Yuan Zhong *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 40 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, Peoples Republic of China), v. 14, no. 3, 20 Mar. 1987 p 159-162 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21366# Joint Publications Research Service, Arlington, Va.
THEORETICAL STUDY OF COLLIDING PULSE MODE-LOCKING IN DYE LASERS
Jutao Chen, Yupu Liu, and Zhijiang Wang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 6-14 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Feb. 1987 p 65-69 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21367# Joint Publications Research Service, Arlington, Va.
PULSED MAGNET FIELDS FOR FREE-ELECTRON LASERS
Jiabiao Shi, Yinnian Pan, and Wei Wang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 15-18 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Feb. 1987 p 120-121 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21757# Joint Publications Research Service, Arlington, Va.
RADIATION ABSORPTION IN NEODYMIUM GLASSES DURING PASSAGE OF STRONG LASER PULSE Abstract Only
V. V. Ivanov, Yu. V. Senatskiy, and G. V. Sklizkov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 410-412 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21758# Joint Publications Research Service, Arlington, Va.
NONLINEARLY TUNABLE WIDEBAND EMISSION OF INFRARED RADIATION BY Al2O3:Ti LASER Abstract Only
D. V. Bakin, L. M. Dorozhkin, Yu. I. Krasilov, N. T. Kuznetsov, and A. V. Shestakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 4, Apr. 1987 p 891-893 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21759# Joint Publications Research Service, Arlington, Va.
TIME CHARACTERISTICS OF ULTRASHORT LIGHT PULSES FROM DYE LASERS WITH DISTRIBUTED FEEDBACK Abstract Only
A. N. Rubinov, B. A. Bushuk, and A. L. Berestov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5-6 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 906-909 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21760# Joint Publications Research Service, Arlington, Va.
KINETICS OF SLOW ELECTRONS IN EXCIMER LASER WITH ELECTRON-BEAM PUMPING Abstract Only
V. A. Adamovich, V. A. Demyanov, N. A. Dyatko, I. V. Kochetov, A. P. Napartovich, and A. P. Streltsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 6 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 5, May 1987 p 937-942 Original language document was announced in IAA as A87-50835 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21761# Joint Publications Research Service, Arlington, Va.
SOLID-STATE RING LASER WITH ACOUSTOOPTICAL PHASE NONRECIPROCITY OF OPPOSING WAVES Abstract Only
Yu. D. Golyayev, A. A. Zadernovskiy, and A. L. Livintsev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 6-7 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 917-919 Original language document was announced in IAA as A88-10757 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21762# Joint Publications Research Service, Arlington, Va.
EMISSION CHARACTERISTICS OF XeCl-LASER EXCITED BY ELECTRON BEAM OF MICROSECOND DURATION Abstract Only
Yu. I. Bychkov, N. G. Ivanov, V. F. Losev, G. A. Mesyats, and V.

V. Ryzhov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 7 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, nop. 5, May 1987 p 953-956 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21763# Joint Publications Research Service, Arlington, Va.
EFFECTS OF EMISSION ENERGY TRANSIENT IN PERIODIC-PULSE XeCl EXCIMER LASER OF APPROXIMATELY 400 W AVERAGE POWER Abstract Only
V. M. Borison, A. Yu. Vinokhodov, and Yu. B. Kiryukhin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 7-8 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 936-942 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21764# Joint Publications Research Service, Arlington, Va.
TUNABLE CONDENSED-MEDIA LASER WITH ANTIRESONANT RING CAVITY Abstract Only
G. S. Kruglik, A. A. Kutsak, G. A. Skripko, V. R. Sender, N. V. Kondratyuk, and L. P. Zharikhina *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 8 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 5, May 1987 p 727-732 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21765# Joint Publications Research Service, Arlington, Va.
NONLINEAR STAGE OF ULTRASHORT-PULSE FORMATION IN SOLID-STATE LASER Abstract Only
M. I. Demchuk, I. A. Manichev, V. P. Mikhaylov, and K. V. Yumashev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 9 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 4, Apr. 1987 p 562-567 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21766# Joint Publications Research Service, Arlington, Va.
HIGH-EFFICIENCY Y-Sc-Ga:Cr (SUP)3+,Tu (SUP)3+,Ho (SUP)3+ GARNET LASER (gl= 2.088 gmm AT ROOM TEMPERATURE Abstract Only
A. N. Alpatyev, Ye. V. Zharikov, S. P. Kalitin, A. F. Umyskov, and I. A. Shcherbakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 9 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 922-923 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21767# Joint Publications Research Service, Arlington, Va.
SPACE-TIME STRUCTURE OF ULTRASHORT LIGHT PULSES FORMED DURING STIMULATED BACKSCATTERING OF LASER BEAM Abstract Only
E. Gayzhauskas, A. Piskareskas, V. Smilgyavichyus, and K. Stalyunas *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 1025-1030 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21768# Joint Publications Research Service, Arlington, Va.
CONTROLLING XeCl-LASER BY MEANS OF EXTERNAL SIGNAL WITH LESS THAN 2 W/cm (SUP)2 INTENSITY Abstract Only
Yu. I. Bychkov, M. L. Vinnik, S. Ye. Kovalenko, and V. F. Losev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 957-958 Original language document was announced in IAA as A88-10764 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21774# Joint Publications Research Service, Arlington, Va.
PULSE DURATION CONTROL OF XeCl*-LASER BY MEANS OF PLASMA SHUTTER Abstract Only
A. N Panchenko and V. F. Tarasenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 23 Transl. into ENGLISH from Fizika Plazmy (Moscow, USSR), v. 13, no. 4, Apr. 1987 p 497-498 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21788# Tokyo Univ. (Japan).
DYNAMIC AND SPECTRAL PROPERTIES OF SEMICONDUCTOR LASERS WITH QUANTUM WELL, QUANTUM WIRE, AND QUANTUM BOX STRUCTURES
Yasuhiko Arakawa *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 147-182 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21789# Tokyo Inst. of Tech., Yokahama (Japan).
ULTRAHIGH COHERENT SEMICONDUCTOR LASERS AND THEIR APPLICATIONS TO Rb ATOMIC CLOCK
M. Ohtsu, K. Kuboki, and M. Hashimoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 183-215 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21808# Tokyo Univ. (Japan). Dept. of Physics.
COMPREHENSIVE MODEL FOR LASER INSTABILITY IN A CO2 LASER WITH GASEOUS SATURABLE ABSORBER
Tadao Shimizu, Maki Tachikawa, and Kazuhito Tanii *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 531-551 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-21445# Japan Atomic Energy Research Inst., Tokyo.
NEW REPRESENTATION FOR KINEMATICS OF MANIPULATOR
Shinobu Sasaki Aug. 1987 26 p In JAPANESE; ENGLISH summary
(DE88-751446; JAERI-M-87-125) Avail: NTIS (US Sales Only) HC A03/MF A01

In place of the homogeneous coordinates transformation method, a vector formulation was introduced to the analysis of manipulator linkage mechanism. After calculating the location and orientation of individual joints, a combined operation of both the orientation of the finger-tip and the inversion of rotation operators led to kinematic descriptions different from those derived in the ordinary way. In addition, among them, direction cosines represented by the sixth joint angle theta/sub 6/ were found to completely correspond to the expression of several parameters defined previously in the course of derivation of an algebraic equation in solving the inverse kinematics, and thereby, implication of each parameter became clear. The present approach will help to derive a variety of relationships between links. DOE

N88-21446# Chloride Legg Ltd., Wolverhampton (England).
DEVELOPMENT OF A TOTAL ELECTRIC VEHICLE DRIVE SYSTEM Final Report
D. Walker 1986 163 p
(Contract EEC-2-221-81-UK(H))

(DE88-900367; EUR-10908) Avail: NTIS (US Sales Only) HC A08/MF A01

The original purpose of this project was to develop a total vehicle control system incorporating a high frequency power supply for both battery charging and motor field control for battery powered traffic compatible electric road vehicles. By 1982 it was realized this aim could not be realized due to suitable semiconductors not being introduced by the manufacturers as soon as anticipated. The project then took the form of the separate development of an electric vehicle controller, a dc-ac converter and an off-board high frequency charger. Considerable operating experience was obtained with each of these products undergoing continuing improvements. Both the controller and the converter went through two major redesigns (Mark 1 and Mark 2). This report describes in detail, the evolution of the three designs, the principles of operation, testing, specification and revisions, and details the major circuit innovations. The bulk of the performance and reliability testing was carried out on complete vehicles which prolonged the data gathering exercise due to vehicle failures not connected with the project components. The relevant vehicle reliability reports are included in the Appendix. At the end of the project, a drive system of good performance, high efficiency, and high reliability was produced. Production of the project was based, unfortunately, stopped in 1985 due to lack of orders. The data and experience obtained from this development now form a basis for current and future development projects and an integrated system will be produced in the next year for production in 1988. DOE

N88-21447# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.

THE QUASI-STATIC CONTACT PROBLEM WITH FRICTION FOR THREE DIMENSIONAL ELASTIC BODIES

J. J. Kalker 1987 16 p

(Rept-87-51; B8731210; ISSN-0920-8577; ETN-88-91859)

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Starting from the weak formulation of the contact problem it is shown that in a number of technologically important cases, such as wheel-rail contact in railroads, and the contacts in roller bearings, the contact formation is independent of the tangential traction. An algorithm for contact formation and one for friction which lead to a solution in a finite number of steps were developed. They were implemented for the elastic half-space, and the computer program is reliable. An amalgamation of the contact formation and the friction algorithms was also implemented. This method, however, does not converge in all possible cases. Contact evolutions, notably steady state rolling, are discussed. ESA

N88-21448# National Bureau of Standards, Gaithersburg, Md.

TOWARDS A TRIBOLOGY INFORMATION SYSTEM: THE RESULTS OF A PLANNING WORKSHOP HELD AT THE NATIONAL BUREAU OF STANDARDS, JULY-AUGUST 1985 Final Report

J. Rumble and L. Sibley Dec. 1987 130 p Sponsored by DOE, Washington, D.C. and American Society of Mechanical Engineering, New York, N.Y.

(PB88-168604; NBS/SP-737; LC-87-619902) Avail: NTIS HC A07/MF A01; also available SOD HC $6.50 as SN003-003-2843-6 CSCL 20C

A workshop was held in July 1985 to address the needs for a computerized tribology information and data system, as well as possible implementation schemes. Specific categories that were treated were design, numeric data, bibliography, research in progress, newsletter, and product directory. The workshop recommendations detailed four phases of development, starting with a demonstration prototype system and concluding with a full-scale operating data and information base. Specific plans in each phase and for each subject area were developed and are presented. While continual input will be sought from the technical community to refine those plans, it is hoped that immediate efforts can begin in at least some of the areas, and that system use will quickly develop to a significant level, both nationally and internationally. GRA

N88-21449# Imperial Coll. of Science and Technology, London (England). Computational Fluid Dynamics Unit.

TWO-FLUID TURBULENCE MODELS AND RECIPROCATING ENGINES

D. B. Spalding 1987 37 p Presented at the ICHMT Dubrovnik Summer School, Aug. - Sep. 1987

(CFD/87/6; ETN-88-91915) Avail: NTIS HC A03/MF A01

Features of reciprocating-engine combustion, and two-fluid turbulence models are outlined. One-dimensional representations of in-cylinder behavior (the phenomenon considered, numerical-parameter studies, physical-parameter studies) are reviewed. Two-dimensional representations of in-cylinder behavior (the phenomenon considered, numerical-parameter studies, physical-parameter studies) are discussed. ESA

N88-21450# Washington Univ., Seattle. Dept. of Civil Engineering.

PERFORMANCE OF ELASTOMERIC BEARINGS Final Report

C. W. Roeder, J. F. Stanton, and A. W. Taylor Oct. 1987 110 p Sponsored by Transportation Research Board, Washington, D.C., Federal Highway Administration, Washington, D.C. and American Association of State Highway and Transporation Officials, Washington, D.C.

(PB88-159470; NCHRP-298; ISBN-0-309-04567-3; LC-87-51180) Avail: NTIS HC A06/MF A01 CSCL 13I

The work reported here represents the second phase of an ongoing study of elastomeric bearings. Phase 1 consisted of a state-of-the-art review and the development of a first level design specification. In Phase 2, tests and analysis were conducted on elastomeric bearings, and the results were used to develop design provisions suitable for inclusion in the AASHTO Specifications. The study consisted of tests and correlations with theory for monotonic compression, rotation, shear and buckling, and for fatigue in shear and compression. It also included a theoretical analysis of a bearing in a bridge subject to low temperatures. GRA

N88-21451# Illinois Univ., Chicago. Dept. of Mechanical Engineering.

COMBUSTION AND PERFORMANCE CHARACTERISTICS OF METHANOL PLUS HIGHER ALCOHOLS IN A SPARK IGNITION ENGINE Final Report

K. S. Patel Nov. 1987 112 p Sponsored by Illinois Dept. of Energy and Natural Resources, Springfield

(PB88-147962; IL/ENR/AE-87/03) Avail: NTIS HC A06/MF A01 CSCL 13I

A study of the physical and chemical properties and performance of methanol plus higher alcohol (MPHA)-indolene was completed. The fuel properties investigated are distillation characteristics, heat of combustion, flash point, specific gravity, water tolerance, and stoichiometry. The performance parameters investigated are MBT spark advance, knock limited compression ratio, brake power, brake mean effective pressure, brake thermal efficiency, and brake specific fuel consumption. The fuel properties of fifteen indolene-alcohol blends were measured at different alcohol concentration in indolene-alcohol blends. GRA

N88-21452# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

IMPACT SHOCK GENERATOR FROM EXPLOSIVELY DRIVEN PLATES

G. E. Korth and R. L. Williamson 1987 12 p Presented at the 5th Topical Conference of the American Physical Society on Shockwaves in Condensed Matter, Monterey, Calif., 20 Jul. 1987

(Contract DE-AC07-76ID-01570)

(DE88-003596; EGG-M-11087; CONF-870753-80) Avail: NTIS HC A03

Experimental methods were developed to produce well-defined impact stress waves from relatively large plates accelerated by commercially available explosives. Steel plates, 180 mm square and from 12.5 to 50 mm thick, are accelerated to velocities from 0.3 to over 1.0 km/s without spalling and produce relatively planar impacts. Numerical modeling was used as an aid in the experiment

design and interpretation of results. Pin gages were used to measure velocity and planarity at impact. DOE

N88-21453# Oak Ridge National Lab., Tenn.
AN EFFICIENT GRADIENT PROJECTION OPTIMIZATION SCHEME FOR A SEVEN-DEGREE-OF-FREEDOM REDUNDANT ROBOT WITH SPHERICAL WRIST
R. V. Dubey, J. A. Euler, and S. M. Babcock 1988 10 p Presented at the IEEE International Conference on Robotics and Automation, Philadelphia, Pa., 25 Apr. 1988 Prepared in cooperation with Tennessee Univ., Knoxville.
(Contract DE-AC05-84OR-21400)
(DE88-005440; CONF-880424-7) Avail: NTIS HC A02/MF A01

A computationally efficient kinematic control scheme is presented for a seven-degree-of-freedom redundant robot with spherical wrist. This scheme uses a gradient projection optimization method, which eliminates the need to determine the generalized inverse of the Jacobian when solving for joint velocities for given Cartesian end-effector velocities. Closed-form solutions are obtained for joint velocities using this approach. The application of this scheme to the seven-degree-of-freedom manipulator at the Center for Engineering Systems Advanced Research (CESAR) is described. DOE

N88-21454*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED TRANSMISSION STUDIES
John J. Coy and Robert C. Bill (Army Aviation Research and Development Command, Cleveland, Ohio.) 1988 15 p Proposed for presentation at the 44th Annual Forum of the American Helicopter Society, Washington, D.C., 16-18 Jun. 1988
(DA Proj. 1L1-62209-AH-76)
(NASA-TM-100867; E-4089; NAS 1.15:100867;
AVSCOM-TR-88-C-002) Avail: NTIS HC A03/MF A01 CSCL 13I

The NASA Lewis Research Center and the U.S. Army Aviation Systems Command share an interest in advancing the technology for helicopter propulsion systems. In particular, this paper presents highlights from that portion of the program in drive train technology and the related mechanical components. The major goals of the program are to increase the life, reliability, and maintainability; reduce the weight, noise, and vibration; and maintain the relatively high mechanical efficiency of the gear train. The current activity emphasizes noise reduction technology and analytical code development followed by experimental verification. Selected significant advances in technology for transmissions are reviewed, including advanced configurations and new analytical tools. Finally, the plan for future transmission research is presented. Author

N88-21193# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
HEMISPHERICAL POINTING MECHANISM DRIVE UNIT
H. H. Schultz *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 11-14 (For primary document see N88-21191 14-18)
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N88-21195# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
SOME HIGHLIGHTS ON ROSAT MECHANISMS
P. Pawlowski and H. Heimerdinger (Dornier-Werke G.m.b.H., Friedrichshafen, West Germany) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 21-25 (For primary document see N88-21191 14-18)
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N88-21196# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
THE CTM PROGRAM OF MASTS AND THE CTM ENGINEERING MODEL
M. Aguirre, R. Bureo, F. delCampo, and M. Fuentes (Sener S.A., Madrid, Spain) *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 27-35 (For primary document see N88-21191 14-18)
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N88-21204# Spar Aerospace Ltd., Weston (Ontario). Canadian Space Station Program.
SYSTEM AND CONCEPT DESIGN OF THE SSRMS LATCHING END EFFECTOR
E. Quittner, R. Vandersluis, J. Rakhsha, and I. Farmer *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 93-103 (For primary document see N88-21191 14-18)
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N88-21205# Sener S.A., Madrid (Spain).
LATCHING MECHANISMS FOR IOC
F. delCampo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 105-112 (For primary document see N88-21191 14-18)
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N88-21206# Contraves Italiana, Rome.
DARM: A NEW DEPLOYMENT AND RETRACTION MECHANISM WHICH DOES NOT NEED ELECTRIC POWER
D. Stella, M. Simonelli, and C. Piredda *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 113-123 Sponsored by CNR (For primary document see N88-21191 14-18)
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N88-21207# Construcciones Aeronauticas S.A., Madrid (Spain). Space Div.
DEPLOYMENT, HOLD DOWN AND RELEASE MECHANISMS FOR WIND SCATTEROMETER ANTENNA (WSA)
A. Nunez, J. G. SanMartin, and P. Luengo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 125-134 (For primary document see N88-21191 14-18)
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N88-21208# European Space Tribology Lab., Risley (England). Northern Research Labs.
MODELS FOR STEADY AND NONSTEADY COULOMB TORQUE IN BALL BEARINGS
M. J. Todd *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 137-148 Sponsored by ESA/ESTEC, Noordwijk, The Netherlands (For primary document see N88-21191 14-18)
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N88-21210# Centre Suisse de Documentation dans le Domaine de la Microtechnique, Neuchatel.
BALL BEARINGS WITH CHEMICAL VAPOR DEPOSITION (CVD)-TIC COATED COMPONENTS
H. Boving, H. E. Hintermann, and W. Haenni *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 155-159 (For primary document see N88-21191 14-18)
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N88-21211# Societe Nationale Industrielle Aerospatiale, Cannes (France).
THE SPOT SOLAR ARRAY. BOX OPENING MECHANISMS PHYSICAL VAPOR DEPOSITION (PVD)-MoS2: LUBRICATED SLIDES. FUNCTIONAL EVALUATION
J. F. Patin, J. L. Cecconi, L. Decramer, and E. Conde (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 161-166 (For primary document see N88-21191 14-18)
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N88-21213# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France).
AN ADVANCED LOW-COST 2-AXIS ACTIVE MAGNETIC BEARING FLYWHEEL
M. Gauthier, J. P. Roland, H. Vaillant, and A. A. Robinson (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 177-182 (For primary document see N88-21191 14-18)
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N88-21214# Societe Anonyme d'Etudes et Realisations Nucleaires, Limeil-Brevannes (France).
HIGH LIFETIME MECHANISMS IMPLEMENTED IN INFRARED HORIZON SCANNING SENSORS
M. Pochard and G. Wallis *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 183-189 (For primary document see N88-21191 14-18)
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N88-21217# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
DESIGN OF A LINEAR ACTUATOR AND BREADBOARD TEST RESULT
R. G. Hostenkamp *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 207-210 (For primary document see N88-21191 14-18)
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N88-21218# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PHOTOELASTIC MODEL TESTS OF THE DORNIER LINEAR ACTUATOR
P. Coste *In its* Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 211-221 (For primary document see N88-21191 14-18)
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N88-21219# Sener S.A., Madrid (Spain).
FINE ADJUSTMENT MECHANISM FOR FIRST
F. delCampo, J. delTorro, and J. Rivacoba *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 223-227 (For primary document see N88-21191 14-18)
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N88-21220# University Coll., London (England). Mullard Space Science Lab.
DEVELOPMENT OF A CRYOGENIC STEPPING DRIVE FOR ISO/LWS
T. J. Patrick and R. C. Sidey (Sidey, R. C., Richmond, England) *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 229-232 (For primary document see N88-21191 14-18)
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N88-21222# Centre National d'Etudes Spatiales, Toulouse (France).
ROBOTIC JOINT PROTOTYPE FOR SPACE APPLICATIONS
A. Borrien and L. Petitjean *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 237-244 (For primary document see N88-21191 14-18)
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N88-21225# Sener S.A., Madrid (Spain).
THE EURECA ANTENNA DEPLOYMENT AND RETRACTION MECHANISMS
M. Fuentes, C. Pascual, and R. Bureo *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 261-266 (For primary document see N88-21191 14-18)
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N88-21226# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
QUALIFICATION OF THE OLYMPUS REACTION WHEEL
G. J. Sturtivant *In* ESA, Proceedings of the 3rd European Space Mechanisms and Symposium Dec. 1987 p 267-272 (For primary document see N88-21191 14-18)
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N88-21227# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
DEVELOPMENT AND QUALIFICATION OF THE OLYMPUS ANTENNA POINTING MECHANISM
P. J. Lovett *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 273-280 (For primary document see N88-21191 14-18)
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N88-21229# British Aerospace Public Ltd. Co., Stevenage (England). Space and Communications Div.
QUALIFICATION TESTING OF THE EUROSTAR SOLAR ARRAY DRIVE MECHANISM (SADM)
I. D. Henderson *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 285-294 (For primary document see N88-21191 14-18)
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N88-21230# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (West Germany).
EVOLUTION OF LARGE MOMENTUM AND REACTION WHEELS
H. Heimel *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 297-302 (For primary document see N88-21191 14-18)
Copyright Avail: NTIS HC A14/MF A01

N88-21232# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
A JOINT ACTUATOR DESIGN FOR A ROBOTIC MANIPULATOR
K. Priesett *In* ESA, Proceedings of the 3rd European Space Mechanisms and Tribology Symposium Dec. 1987 p 311-316 (For primary document see N88-21191 14-18)
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N88-21323# Joint Publications Research Service, Arlington, Va.
OPTIMIZATION OF OXYGEN CUTTING PROCESS FOR TITANIUM ALLOYS Abstract Only
V. I. Trusov, V. V. Khilchevskiy, and A. Ye. Goldshteyn *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 65 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 9, Sep. 1986 p 3-4 Original language document was announced in IAA as A87-50026 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21324# Joint Publications Research Service, Arlington, Va.
EFFICIENCY OF FUSION DURING PERIODIC-PULSE LASER-BEAM WELDING Abstract Only
G. I. Levin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 66-67 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 9, Sep. 1986 p 9-10 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21325# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF WELDS JOINING PARTS OF HIGH-STRENGTH PIPE STEELS AND PRODUCED BY BEAM OF CONTINUOUS-WAVE CO2-LASER Abstract Only
E. S. Lurye and I. A. Shmeleva *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 67 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow,

USSR), no. 9, Sep. 1986 p 17-18 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21327# Joint Publications Research Service, Arlington, Va.
FRICTION WELDING: ADVANCED METHOD OF PRODUCING END CUTTING TOOL Abstract Only
V. A. Solovyev, G. P. Goloviznina, E. Kh. Arkhipova, and A. Ye. Korchemkin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 70-71 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 2-4 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21328# Joint Publications Research Service, Arlington, Va.
INERTIA WELDING WITH VARIABLE MAGNITUDE OF IMPACT LOAD Abstract Only
E. S. Karakozov, V. I. Kominov, V. I. Yegorov, and V. V. Levashov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 72 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 5-6 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21330# Joint Publications Research Service, Arlington, Va.
OPTIMUM DURATION OF STEADY-STATE STAGE IN FRICTION WELDING OF METALS WITHOUT ARTIFICIAL BRAKING Abstract Only
A. S. Seregin *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 73 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 7-9 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21331# Joint Publications Research Service, Arlington, Va.
ENSURING HIGHER STABILITY OF IMMERSED-ARC WELDING OF STRUCTURAL ALUMINUM ALLOYS AND MAGNESIUM ALLOYS Abstract Only
A. F. Nesterov, Ye. A. Bulgachev, and N. B. Boytsov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 75 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 10, Oct. 1986 p 13-14 Original language document was announced in IAA as A87-50029 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21333# Joint Publications Research Service, Arlington, Va.
DIFFUSION WELDING OF ALUMINOMAGNESIUM ALLOYS TO CERAMICS Abstract Only
V. A. Bachin, E. A. Goritskaya, I. Ye. Tikhonova, and K. E. Tsiolkovskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 79 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 17-19 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21334# Joint Publications Research Service, Arlington, Va.
THE EFFECT OF SURFACE TENSION IN THE WELD POOL ON SEAM FORMATION WHEN WELDING THIN SHEET WITH LIGHT RAYS Abstract Only
S. A. Fedorov and V. V. Ovchinnikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 80-81 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 33-35 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21469*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 15-METER DIAMETER HOOP/COLUMN ANTENNA SURFACE CONTROL ACTUATOR SYSTEM
Elvin L. Ahl, Jr. and James B. Miller *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 1-11 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

N88-21470*# Maus Technologies, Boulder, Colo.
HIGH OUTPUT PARAFFIN ACTUATORS: UTILIZATION IN AEROSPACE MECHANISMS
Scott Tibbitts *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 13-28 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

N88-21471*# Rexnord Aerospace Mechanisms, Torrance, Calif.
STRUCTURAL LATCHES FOR MODULAR ASSEMBLY OF SPACECRAFT AND SPACE MECHANISMS
William McCown and Neal Bennett *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 29-44 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

N88-21474*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MOTION SYNCHRONIZATION OF A MECHANISM TO DEPLOY AND RESTOW A TRUSS BEAM
M. Lucy *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 67-85 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

N88-21475*# Old Dominion Univ., Norfolk, Va.
ON THE DANGER OF REDUNDANCIES IN SOME AEROSPACE MECHANISMS
M. Chew *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium, May 1988 p 87-98 (For primary document see N88-21468 14-39)
(Contract NAS1-17993)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21476*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
QUICK ACTUATING CLOSURE AND HANDLING SYSTEM
Johnny W. Allred, Dorsey E. White, III, Benjamin T. Updike, and Peyton B. Gregory *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 99-114 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

N88-21477*# Lockheed Missiles and Space Co., Palo Alto, Calif.
DEVELOPMENT OF A MOTORIZED CRYOVALVE FOR THE CONTROL OF SUPERFLUID LIQUID HELIUM
K. R. Lorell, J-N. Aubrun, D. F. Zacharie, and D. J. Frank *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 115-131 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13K

N88-21478*# Toshiba Corp., Kawasaki (Japan). Mechanical Engineering Lab.
DEVELOPMENT OF A MAGNETICALLY SUSPENDED, TETRAHEDRON-SHAPED ANTENNA POINTING SYSTEM
Kenichi Takahara, Tamane Ozawa, Hiroshi Takahashi, Shitta Shingu, Toshiro Ohashi, and Hitoshi Sugiura *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 133-147 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21482*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT OF DRIVE MECHANISM FOR AN OSCILLATING AIRFOIL
Clifford D. Sticht *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 189-197 (For

primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21483*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIBRATION ISOLATION SYSTEM FOR THE STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY (SOFIA)
T. Kaiser and N. Kunz *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 199-209 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21484*# Ball Aerospace Systems Div., Boulder, Colo.
EXPERIENCE WITH DUPLEX BEARINGS IN NARROW ANGLE OSCILLATING APPLICATIONS
D. D. Phinney, C. L. Pollard, and J. T. Hinricks *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 211-226 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21485*# Hughes Space and Communications Group, Los Angeles, Calif.
ON THE TORQUE AND WEAR BEHAVIOR OF SELECTED THIN FILM MOS2 LUBRICATED GIMBAL BEARINGS
John J. Bohner and Peter L. Conley *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 227-244 (For primary document see N88-21468 14-39)
(Contract NAS5-20769)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21487*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TWO GIMBAL BEARING CASE STUDIES: SOME LESSONS LEARNED
Stuart H. Loewenthal *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 253-269 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21489*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL EXPERIENCE AND DESIGN RECOMMENDATIONS FOR TELEOPERATED FLIGHT HARDWARE
T. W. Burgess, D. P. Kuban (Oak Ridge National Lab., Tenn.), W. W. Hankins, and R. W. Mixon *In its* The 22nd Aerospace Mechanisms Symposium May 1988 p 287-305 (For primary document see N88-21468 14-39)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21490*# Centre National d'Etudes Spatiales, Toulouse (France).
ROBOTIC JOINT EXPERIMENTS UNDER ULTRAVACUUM
A. Borrien and L. Petitjean *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 307-324 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

N88-21493*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DEVELOPMENT OF A ROTARY FLUID TRANSFER COUPLING AND SUPPORT MECHANISM FOR SPACE STATION
O. H. Bradley, Jr., J. A. Costulis, and A. H. Porter (PRC Kentron, Inc., Hampton, Va.) *In its* The 22nd Aerospace Mechanisms Symposium May 1988 p 355-371 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13K

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-21455 British Library Lending Div., Boston Spa (England).
STATISTICAL ANALYSIS OF FEASIBILITY OF NON-DESTRUCTIVE INSPECTION OF MECHANICAL PROPERTIES OF HOT WORKED PIPES OF ALLOY STEELS
V. F. Ryabov, V. V. Tarasov, O. A. Chikalova, and E. Yu. Timofeeva 1987 7 p Transl. into ENGLISH from Stal (USSR), no. 7, 1987 p 70-72
(BLL-M-37598-(5828.4)) Avail: British Library Lending Div., Boston Spa, United Kingdom

An examination was made of the relationship between the mechanical properties and the demagnetization current of the metal of hot worked pipes of alloy steels. The results of regression-correlation analysis indicate the feasibility of determining the mechanical properties of the hot worked pipes from their demagnetization current. The proposed procedure for nondestructive inspection involves the use of a ferroprobe coercimeter. Author

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N88-21456*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCES IN CONTACT ALGORITHMS AND THEIR APPLICATION TO TIRES
Ahmed K. Noor and John A. Tanner Apr. 1988 36 p Presented at the American Chemical Society Meeting, Montreal, Quebec, 26-29 May 1987 Original contains color illustrations
(NASA-TP-2781; L-16376; NAS 1.60:2781) Avail: NTIS HC A03/MF A01 CSCL 20K

Currently used techniques for tire contact analysis are reviewed. Discussion focuses on the different techniques used in modeling frictional forces and the treatment of contact conditions. A status report is presented on a new computational strategy for the modeling and analysis of tires, including the solution of the contact problem. The key elements of the proposed strategy are: (1) use of semianalytic mixed finite elements in which the shell variables are represented by Fourier series in the circumferential direction and piecewise polynomials in the meridional direction; (2) use of perturbed Lagrangian formulation for the determination of the contact area and pressure; and (3) application of multilevel iterative procedures and reduction techniques to generate the response of the tire. Numerical results are presented to demonstrate the effectiveness of a proposed procedure for generating the tire response associated with different Fourier harmonics. Author

N88-21457# Los Alamos National Lab., N. Mex.
MATERIALS DEPENDENCE OF DEFORMATION TEXTURE DEVELOPMENT IN VARIOUS DEFORMATION MODES
M. G. Stout, J. S. Kallend, U. F. Kocks, M. A. Przystupa, and A. D. Rollett 1987 7 p Presented at the 8th International Conference on Textures of Materials, Santa Fe, N. Mex., 21 Sep. 1987 Prepared in cooperation with Illinois Inst. of Tech., Chicago and Przystupa (M. A.), Redondo, Beach, Calif.
(Contract W-7405-eng-36)
(DE88-004312; LA-UR-87-4088; CONF-8709172-6) Avail: NTIS HC A02/MF A01

Attempts to understand the development of deformation textures have long been hampered by the following dichotomy: in theory, one expects orientation changes to be governed entirely by the geometry of deformation and thus, to be the same for all

materials of the same lattice structure and the same deformation modes; yet in experiments, one observes differences between different materials of the same lattice structure. The current work represents an effort to address this problem anew. Four fcc single-phase materials (aluminium, copper, silver, and 70:30 brass) were deformed along three strain-paths (wire-drawing, compression, and torsion), with complete texture determinations before deformation and after strains of roughly 1.0 and 2.0. In parallel, 800 randomly oriented but weighted grains were subjected to simulation of these same tests by the Los Alamos polycrystal plasticity (LApp) code, taking account of the initial textures. An ancillary question which could be addressed in this way is how long initial textures can be remembered by the material; the answer depends on the circumstances and is not always small strains. DOE

N88-21458# Sydney Univ. (Australia). School of Civil and Mining Engineering.

UNRESTRAINED OUT-OF-PLANE BUCKLING OF MONOSYMMETRIC RINGS

J. G. Teng and J. M. Rotter Dec. 1986 43 p

(PB88-155213; R-536) Avail: NTIS HC A03/MF A01 CSCL 20K

Rings which are loaded by a uniformly distributed radial inward load may buckle out of the plane of the ring. This study is concerned with out-of-plane buckling of rings of monosymmetric section with the axis of symmetry oriented radially. It is assumed that there are no restraints against buckling displacements. A new solution to the problem is derived and compared extensively with existing analytical solutions and finite element analysis. All the existing solutions are shown to be either limited in application or in error. The new solution compares well with finite element analysis, provided that there is no distortion of the cross-section. Author

N88-21459# Technical Research Centre of Finland, Espoo. Metals Lab.

THE NORDIC J-R CURVE ROUND ROBIN TEST PROGRAM Final Report

Kim Wallin Nov. 1987 41 p Sponsored by the Nordic Liaison Committee of Atomic Energy

(VTT-RR-510; ISBN-9-51-383009-8; ISSN-0358-5077; ETN-88-91877) Copyright Avail: NTIS HC A03/MF A01; Technical Research Center of Finland, P.O. Box 516, SF-00101, Helsinki, Finland 40 FIM

Reactor pressure vessel steel J-R-curve round robin test results are presented. The results show a large amount of scatter. It is not possible to conclusively state whether the scatter is due to the material inhomogeneity or to the different laboratory practices. The round robin exercise, however, does give valuable information regarding the reliability to be expected in J-R-curves obtained by standard procedures. It is evident that the present J-R-curve testing procedures need refinement. ESA

N88-21460# Bristol Univ. (England). Dept. of Aerospace Engineering.

STRESS-STRAIN BEHAVIOUR OF A BOLT HOLE IN CARBON FIBRE COMPOSITE PLATES B.E. Thesis

U. M. Graham and C. G. M. Critchett Jun. 1987 71 p

(BU-354; ETN-88-91894) Avail: NTIS HC A04/MF A01

Two 19-ply carbon fiber composite laminates of XAS/914C and AS4/PEEK material were examined. Using classical laminated plate theory, embodying a maximum strain to failure criterion, predicted stiffness and strength are respectively over and under those values obtained from test work. A single hole was subjected to combinations of tensile and bearing loads and local strains were measured with strain gages. Predicted failure, which was defined as fiber failure at the most highly stressed point around the hole, is seen to correspond with yield rather than catastrophic failure of the laminate. A clear hole causes up to a 60 percent laminate strength reduction, and the presence of an unloaded bolt modifies this to 50 percent. Both materials have an ultimate bearing strength of 560 N/sq mm. Measured elastic strain variations around the hole confirm trends predicted by a finite element analysis. Superposition of strain fields from finite element models of pure bearing and bypass loading correlates reasonably well with that from a dedicated model for combined bearing/bypass loading. ESA

N88-21461# Bristol Univ. (England). Dept. of Aerospace Engineering.

STRUCTURAL AND MATERIAL TESTING OF A COMPOSITE MICROLITE WING MODEL B.E. Thesis

G. R. Deanus and M. J. Elwell Jun. 1987 83 p Original contains color illustrations

(BU-355; ETN-88-91895) Avail: NTIS HC A05/MF A01

A composite wing structure made from foam supported GFRP sheet material, proposed as a replacement for the conventionally constructed wing used on the MW5 microlight aircraft was studied. A full chord, one third span wing model was used for testing. Simulation of a critical load case and torsion tests were carried out, followed by an ultimate load test. Failure occurs at 2.3 times the proof load and reveals failure mechanisms which should be considered in future designs. Material tests establish the composite's true properties, and contribute to explaining the discrepancy between experimental and theoretical stress values. Weight analysis of the composite was carried out, but further work is necessary to achieve significant weight reduction. The separate effects of damage and reducing foam thickness were investigated in a series of panel buckling tests. The foam thickness tests were compared with values found by laminated plate buckling theory and a good correlation between the two is seen. ESA

N88-21462# Bristol Univ. (England). Dept. of Aerospace Engineering.

MATERIALS TESTING AT CRYOGENIC TEMPERATURES B.E. Thesis

C. Holborn and I. W. R. Walton Jun. 1987 58 p

(BU-359; ETN-88-91899) Avail: NTIS HC A04/MF A01

A thermal expansion rig and tensile testing facility were developed such that investigation of composite behavior at liquid nitrogen temperatures is possible. Techniques and procedures necessary for cryogenic testing are discussed, including the acquiring of an understanding of the apparatus. Details of the fundamental theory behind low-temperature work are presented. Experience gained through development of the apparatus enabled proposals for improvements to both rigs to be put forward, together with possible future applications of the apparatus and the necessary adaptations. Heat transfer within both sets of apparatus, and the effects of liquid helium on a typical composite, are also described. ESA

N88-21463 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.

THE MECHANICAL PROPERTIES OF CARD MEASURED BY PHOTOGRAPHIC MOIRE

A. Kearney and C. Forno May 1987 24 p

(NPL-DMOM-87; ISSN-0309-3069; ETN-88-91910) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

A Moire technique using a slightly modified SLR camera to measure strain in soft and compliant materials was developed. Investigations into optical techniques for deformation measurement indicate that Moire techniques are particularly attractive for card and paper materials. They do not influence the mechanical properties and offer a means of displaying the full-field strain distributions, so that areas of high strain can be readily identified. It is discovered that card can exhibit an unusually low value for Poisson's ratio and the classical shape of a tensile test specimen is unsuitable for this material. ESA

N88-21464# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.

EXPERIMENTS ON THE CREEP BEHAVIOR OF SEMIFINISHED X10NICrAITI 32 20 (NICROFER 32 20) TUBES UNDER MULTIAXIAL LOADING Ph D. Thesis - Technische Hochschule, Aachen, Fed. Republic of Germany

K. Franzke, H. J. Penkalla, M. Roedig, F. Schubert, and H. Nickel May 1987 174 p In GERMAN; ENGLISH summary
(JUEL-2127; ISSN-0366-0885; ETN-88-91930) Avail: NTIS HC A08/MF A01

For power plant components, the transferability of materials data from standard samples to the semifinished materials used for the installations was studied. To test transferability in the creep region for temperatures above 800 C, multiaxial creep tests were performed using tubes in a semifinished state. The results were compared with the results of uniaxial creep tests using standard samples. At 950 C microstructural changes occur in the tested material (X10NiCrAlTi 32 20, Nicrofer 32 20) which result in a creep behavior which can not be described directly by Norton's creep equation. There are significant differences in the creep behavior of the various product forms tested; tubes show significant creep hardening in the primary creep range and a delayed onset of the secondary creep range compared with bar material. Differences are caused by cold work introduced during straightening of the semifinished materials. In spite of the differences in the creep behavior, the transferability of materials data is possible, if a conservative method (reference stress of Treska, calculated from the highest stresses in the semifinished material) of stress calculation is used. ESA

N88-21465# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
PROBABILISTIC ANALYSIS OF CRACK CONTAINING STRUCTURES WITH THE PARIS CODE
A. Brueckner-Foit Oct. 1987 89 p
(KfK-4286; ISSN-0303-4003; ETN-88-91943) Copyright Avail: NTIS HC A05/MF A01

The basic features of the PARIS code for the calculation of failure probabilities of crack containing structures are explained. An important issue in the reliability analysis of cracked components is the probabilistic leak-before-break behavior. Formulas for the leak and break probabilities are derived and it is shown how a leak detection system influences the results. An example taken from nuclear technology illustrates the details of the probabilistic leak-before-break analysis. ESA

N88-21466# Oxford Univ. (England). Dept. of Engineering Science.
THE EFFECT OF STRAIN RATE ON THE STRENGTH AND DUCTILITY OF SiCw/2124 Al COMPOSITE
J. Harding, M. Taya, B. Derby, and S. Pickard 1987 71 p
(OUEL-1692/87; ETN-88-92035) Avail: NTIS HC A04/MF A01

Tensile stress-strain curves were obtained for 2124 Al/SiC whisker composite with 15 and 25 percent volume fractions of reinforcement at strain rates of 0.1, 20, and 1000/sec. For both composites the flow stress increases slightly between the quasi-static and the impact rates but the 25 percent volume fraction materials shows an anomalous reduction in strength at the intermediate rate of 10/sec. A small variation in tensile modulus for both materials reflects the variation with strain rate of the flow stress at 1/2 percent plastic strain. The most marked effect of strain rate is on the strain to fracture which increases from 1 to 3 percent, for the 25 percent SiC material, and from 4 to 8 percent, for the 15 percent SiC material. Metallographic examination reveals ductile fracture surfaces with cup-and-cone type dimples, usually associated with the presence of SiC whiskers, in both materials at all three strain rates. Dislocation density measurements suggest that in the 15 percent SiC material the increased strain to fracture at impact rates of strain could not be due to plastic flow at constant volume and must therefore relate to an increase in volume with only localized plastic flow. Impact tests on the 15 percent SiC specimens show extensive void formation and cracking close to the fracture surface. Increased failure strain at high rates of loading is related to an increase in volume in the damage zone close to the fracture surface. ESA

N88-21467*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTATIONAL ASPECTS OF SENSITIVITY CALCULATIONS IN TRANSIENT STRUCTURAL ANALYSIS
William H. Greene and Raphael T. Haftka Apr. 1988 37 p
(NASA-TM-100589; NAS 1.15:100589) Avail: NTIS HC A03/MF A01 CSCL 20K

A key step in the application of formal automated design techniques to structures under transient loading is the calculation of sensitivities of response quantities to the design parameters. This paper considers structures with general forms of damping acted on by general transient loading and addresses issues of computational errors and computational efficiency. The equations of motion are reduced using the traditional basis of vibration modes and then integrated using a highly accurate, explicit integration technique. A critical point constraint formulation is used to place constraints on the magnitude of each response quantity as a function of time. Three different techniques for calculating sensitivities of the critical point constraints are presented. The first two are based on the straightforward application of the forward and central difference operators, respectively. The third is based on explicit differentiation of the equations of motion. Condition errors, finite difference truncation errors, and modal convergence errors for the three techniques are compared by applying them to a simple five-span-beam problem. Sensitivity results are presented for two different transient loading conditions and for both damped and undamped cases. Author

N88-21468*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 22ND AEROSPACE MECHANISMS SYMPOSIUM
May 1988 416 p Symposium held in Hampton, Va.; sponsored by NASA, Washington, California Inst. of Tech., Pasadena, and LMSC, Sunnyvale, Calif.
(NASA-CP-2506; L-16433; NAS 1.55:2506) Avail: NTIS HC A18/MF A01 CSCL 20K

The proceedings of the symposium, which was held at the NASA Langley Research Center, on May 4 to 6, 1988, are reported. Technological areas covered include space lubrication, bearings, aerodynamic devices, spacecraft latches, deployment, positioning, and pointing. Devices for space station docking and manipulator and teleoperator mechanisms are also described. For individual titles, see N88-21469 through N88-21496.

N88-21469*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE 15-METER DIAMETER HOOP/COLUMN ANTENNA SURFACE CONTROL ACTUATOR SYSTEM c37
Elvin L. Ahl, Jr. and James B. Miller *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 1-11 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

The design, development, and implementation status of the Surface Control Actuator System (SCAS) for the Hoop/Column Antenna are described with the primary focus on the design of the mechanical element. The SCAS is an electromechanical system that will automatically adjust the antenna shape by changing the length of control cords. Achieving and maintaining the proper surface shape and smoothness are critical to optimizing the electromagnetic characteristics of the antenna. Author

N88-21470*# Maus Technologies, Boulder, Colo.
HIGH OUTPUT PARAFFIN ACTUATORS: UTILIZATION IN AEROSPACE MECHANISMS c37
Scott Tibbitts *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 13-28 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

High Output Paraffin (HOP) thermal actuators were developed to provide an alternative to conventional aerospace actuators: HOP actuators directly convert temperature changes to useful mechanical work. When fabricated with internal resistance heating elements, they provide an electric linear motor. For applications

in which slower response times are acceptable or preferred, HOP actuators have distinct advantages over conventional approaches. E.R.

N88-21471*# Rexnord Aerospace Mechanisms, Torrance, Calif.
STRUCTURAL LATCHES FOR MODULAR ASSEMBLY OF SPACECRAFT AND SPACE MECHANISMS c37
William McCown and Neal Bennett *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 29-44 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

Latching techniques are changing from early approaches due to the advent of berthing technology. Latch selection for a given interface may be conducted by evaluating candidate capabilities which meet functional interface requirements. A judgment criteria system is presented along with an example of its use in choosing the Rollerscrew Structural Latch (RSL) for the NASA Flat Plate Interface Prototype (FPIP). Details are given on Rollerscrew operation, design, and development difficulties. A test plan is also outlined for the RSL and FPIP. Author

N88-21472*# AEC-Able Engineering Co., Inc., Goleta, Calif.
THERMALLY STABLE DEPLOYABLE STRUCTURE
Colleen M. Kegg *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium, May 1988 p 45-57 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 20K

A deployable structure which meets stringent thermal and strength requirements in a space environment was developed. A mast with a very low coefficient of thermal expansion (CTE) was required to limit the movement from thermal distortion over the temperature range of -200 C to 80 C to .064 cm (.025 in). In addition, a high bending strength over the temperature range and weight less than 18.1 kg (40 lbs) was needed. To meet all of the requirements, a composite, near-zero CTE structure was developed. The measured average CTE over the temperature range for the mast was .70 x .000001/C (.38 x .000001/F). The design also has the advantage of being adjustable to attain other specific CTE if desired. Author

N88-21473*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE X-BEAM AS A DEPLOYABLE BOOM FOR THE SPACE STATION c18
Louis R. Adams *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 59-66 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

Extension of antennas and thrust modules from the primary structure of the space station will require deployable beams of high stiffness and strength, as well as low mass and package volume. A square boom cross section is desirable for interface reasons. These requirements and others are satisfied by the X-beam. The X-beam folds by simple geometry, using single-degree-of-freedom hinges at simple angles, with no strain during deployment. Strut members are of large diameter with unidirectional graphite fibers for maximum beam performance. Fittings are aluminum with phosphor bronze bushings so that compliance is low and joint lifetime is high. The several beam types required for different applications on the space station will use the same basic design, with changes in strut cross section where necessary. Deployment is by a BI-STEM which pushes the beam out; retraction is by cables which cause initial folding and pull the beam in. Author

N88-21474*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MOTION SYNCHRONIZATION OF A MECHANISM TO DEPLOY AND RESTOW A TRUSS BEAM c37
M. Lucy *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 67-85 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

The functions of the Control of Flexible Structures I (COFS I) deployer and retractor assembly (DRA) are primarily to deploy and retract the Mast I beam, and secondarily to latch, unlatch, and restow the DRA mechanism. The problems associated with the diagonal folding mechanism that retracts the beam is presented, the synchronization requirements critical to the process of restowing the beam is discussed, and a proposed solution to the problem of synchronization between the mechanical systems is presented. In addition, a detailed description is presented of the design and functioning of the DRA. Author

N88-21475*# Old Dominion Univ., Norfolk, Va.
ON THE DANGER OF REDUNDANCIES IN SOME AEROSPACE MECHANISMS c37
M. Chew *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium, May 1988 p 87-98 (For primary document see N88-21468 14-39)
(Contract NAS1-17993)
Avail: NTIS HC A18/MF A01 CSCL 13I

An attempt is made to show that redundancies in some aerospace mechanisms do not generally improve the odds for success. Some of these redundancies may even be the very cause for failure of the system. To illustrate this fallacy, two designs based on the Control of Flexible Structures I (COFS I) Mast deployer and retractor assembly (DRA) are presented together with novel designs to circumvent such design inadequacies, while improving system reliability. Author

N88-21476*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
QUICK ACTUATING CLOSURE AND HANDLING SYSTEM c37
Johnny W. Allred, Dorsey E. White, III, Benjamin T. Updike, and Peyton B. Gregory *In its* The 22nd Aerospace Mechanisms Symposium, May 1988 p 99-114 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13E

A quick activating closure and handling system, which utilizes conical sections for locking, was developed to allow quick access to the combustor internal components of the 8 ft High Temperature Tunnel. These critical components include the existing methane spraybar, a transpiration cooled nozzle and the new liquid oxygen (LOX) injection system housed within the combustor. A substantial cost savings will be realized once the mechanism is installed since it will substantially reduce the access time and increase the time available for conducting wind tunnel tests. A need exists for more frequent inspections when the wind tunnel operates at the more severe conditions generated by using LOX in the combustor. A loads analysis and a structural (finite element) analysis were conducted to verify that the new closure system is compatible with the existing pressure shell. In addition, strain gages were placed on the pressure vessel to verify how the pressure shell reacts to transient pressure loads. A scale model of the new closure system was built to verify the operation of the conical sections in the locking mechanisms. Author

N88-21477*# Lockheed Missiles and Space Co., Palo Alto, Calif.
DEVELOPMENT OF A MOTORIZED CRYOVALVE FOR THE CONTROL OF SUPERFLUID LIQUID HELIUM c37
K. R. Lorell, J-N. Aubrun, D. F. Zacharie, and D. J. Frank *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 115-131 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13K

Recent advances in the technology of infrared detectors have made possible a wide range of scientific measurements and investigations. One of the requirements for the use of sensitive IR detectors is that the entire instrument be cooled to temperatures approaching absolute zero. The cryogenic cooling system for these instruments is commonly designed as a large dewar containing liquid helium which completely surrounds the apparatus. Thus, there is a need for a remotely controlled, motorized cryovalve that is simple, reliable, and compact and can operate over extended

periods of time in cryo-vac conditions. The design, development, and test of a motorized cryovalve with application to a variety of cryogenic systems currently under development is described.
Author

N88-21478*# Toshiba Corp., Kawasaki (Japan). Mechanical Engineering Lab.
DEVELOPMENT OF A MAGNETICALLY SUSPENDED, TETRAHEDRON-SHAPED ANTENNA POINTING SYSTEM c37
Kenichi Takahara, Tamane Ozawa, Hiroshi Takahashi, Shitta Shingu, Toshiro Ohashi, and Hitoshi Sugiura *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 133-147 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

A magnetically suspended, tetrahedron-shaped antenna pointing system is proposed for use in a multibeam broadcasting satellite system in the future. The structure of this system is presented, along with its design concept and the functional test results which were obtained in a laser tracking system in the laboratory. According to these results, it has been confirmed that the system has many advantages over conventional systems and excellent performance.
Author

N88-21479*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
A SPIN AND DEPLOYMENT MECHANISM c18
David W. Preston and Todd A. Girkins *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 149-161 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

The spin ejector was developed as a simple and reliable mechanism to spin and deploy small payloads from an Earth orbiting platform. It is one component of a complete system for retaining a payload during vehicle ascent, releasing the payload for deployment, deploying the payload, and securing the payload canister after deployment. The complete system was designed, fabricated and qualified for flight in just over a year, with the flight article delivered to the launch site in October 1987. The complete system is briefly described, and then the focus in on the deployment mechanism (spin ejector) design concept and test program.
Author

N88-21480*# Lockheed Space Operations Co., Cocoa Beach, Fla.
CONTROLLING STRESS CORROSION CRACKING IN MECHANISM COMPONENTS OF GROUND SUPPORT EQUIPMENT c26
W. A. Majid *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 163-174 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 11F

The selection of materials for mechanism components used in ground support equipment so that failures resulting from stress corrosion cracking will be prevented is described. A general criteria to be used in designing for resistance to stress corrosion cracking is also provided. Stress corrosion can be defined as combined action of sustained tensile stress and corrosion to cause premature failure of materials. Various aluminum, steels, nickel, titanium and copper alloys, and tempers and corrosive environment are evaluated for stress corrosion cracking.
Author

N88-21481*# Stanford Univ., Calif. Dept. of Mechanical Engineering.
KINEMATIC SUPPORT USING ELASTIC ELEMENTS
Arni Geirsson and Daniel B. DeBra *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 175-188 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 20K

The design of kinematic supports using elastic elements is reviewed. The two standard methods (cone, Vee and flat and three Vees) are presented and a design example involving a machine tool metrology bench is given. Design goals included thousandfold strain attenuation in the bench relative to the base when the base strains due to temperature variations and shifting loads. Space applications are also considered.
Author

N88-21482*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEVELOPMENT OF DRIVE MECHANISM FOR AN OSCILLATING AIRFOIL c37
Clifford D. Sticht *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 189-197 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

The design and development of an in-draft wind tunnel test section which will be used to study the dynamic stall of airfoils oscillating in pitch is described. The hardware developed comprises a spanned airfoil between schleiren windows, a four bar linkage, flywheels, a drive system and a test section structure.
Author

N88-21483*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIBRATION ISOLATION SYSTEM FOR THE STRATOSPHERIC OBSERVATORY FOR INFRARED ASTRONOMY (SOFIA) c37
T. Kaiser and N. Kunz *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 199-209 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

The Vibration Isolation System for the Stratospheric Observatory for Infrared Astronomy (SOFIA) is studied. Included are discussions of the various concepts, design goals, concerns, and the proposed configuration for the Vibration Isolation System.
Author

N88-21484*# Ball Aerospace Systems Div., Boulder, Colo.
EXPERIENCE WITH DUPLEX BEARINGS IN NARROW ANGLE OSCILLATING APPLICATIONS c37
D. D. Phinney, C. L. Pollard, and J. T. Hinricks *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 211-226 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

Duplex ball bearings are matched pairs on which the abutting faces of the rings have been accurately ground so that when the rings are clamped together, a controlled amount of interference (preload) exists across the balls. These bearings are vulnerable to radial temperature gradients, blocking in oscillation and increased sensitivity to contamination. These conditions decrease the service life of these bearings. It was decided that an accelerated thermal vacuum life test should be conducted. The test apparatus and results are described and the rationale is presented for reducing a multiyear life test on oil lubricated bearings to less than a year.
Author

N88-21485*# Hughes Space and Communications Group, Los Angeles, Calif.
ON THE TORQUE AND WEAR BEHAVIOR OF SELECTED THIN FILM MOS2 LUBRICATED GIMBAL BEARINGS c37
John J. Bohner and Peter L. Conley *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 227-244 (For primary document see N88-21468 14-39)
(Contract NAS5-20769)
Avail: NTIS HC A18/MF A01 CSCL 13I

During the thermal vacuum test phase of the GOES 7 spacecraft, the primary scan mirror system exhibited unacceptably high drive friction. The observed friction was found to correlate with small misalignments in the mirror structure and unavoidable loads induced by the vehicle spin. An intensive effort to understand and document the performance of the scan mirror bearing system under these loads is described. This effort involved calculation of the bearing loads and expected friction torque, comparison of the computed values to test data, and verification of the lubrication system performance and limitations under external loads. The study

culminated in a successful system launch in February of 1987. The system has operated as predicted since that time. Author

N88-21486*# Swiss Center for Electronics and Microtechnology, Inc., Neuchatel.
TITANIUM CARBIDE COATINGS FOR AEROSPACE BALL BEARINGS c27
Hans J. Boving, Werner Haenni, and Hans-E. Hintermann *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 245-252 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 11C

In conventional ball bearings, steel to steel contacts between the balls and the raceways are at the origin of microwelds which lead to material transfer, surface roughening, lubricant breakdown, and finally to a loss in the bearing performances. To minimize the microwelding tendencies of the contacting partners it is necessary to modify their surface materials; the solid to solid collisions themselves are difficult to avoid. The use of titanium carbide coated steel balls can bring spectacular improvements in the performances and lifetimes of both oil-grease lubricated and oil-grease free bearings in a series of severe applications. Author

N88-21487*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
TWO GIMBAL BEARING CASE STUDIES: SOME LESSONS LEARNED c37
Stuart H. Loewenthal *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 253-269 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

Two troublesome, torque related problems associated with gimbal actuators are discussed. Large, thin section angular contact bearings can have a surprisingly high torque sensitivity to radial thermal gradients. A predictive thermal-mechanical bearing analysis, as described, was helpful in establishing a safe temperature operating envelope. In the second example, end-of-travel torque limits of an oscillatory gimbal bearing appoached motor stall during limit cycling life tests. Bearing modifications required to restore acceptable torque performance are described. The lessons learned from these case studies should benefit designers of precision gimbals where singular bearing torque related problems are not uncommon. Author

N88-21488*# Astro Aerospace Corp., Carpinteria, Calif.
SPACE STATION MOBILE TRANSPORTER c16
James Renshall, Geoff W. Marks, and Grant L. Young *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 271-286 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

The first quarter of the next century will see an operational space station that will provide a permanently manned base for satellite servicing, multiple strategic scientific and commercial payload deployment, and Orbital Maneuvering Vehicle/Orbital Transfer Vehicle (OMV/OTV) retrieval replenishment and deployment. The space station, as conceived, is constructed in orbit and will be maintained in orbit. The construction, servicing, maintenance and deployment tasks, when coupled with the size of the station, dictate that some form of transportation and manipulation device be conceived. The Transporter described will work in conjunction with the Orbiter and an Assembly Work Platform (AWP) to construct the Work Station. The Transporter will also work in conjunction with the Mobile Remote Servicer to service and install payloads, retrieve, service and deploy satellites, and service and maintain the station itself. The Transporter involved in station construction when mounted on the AWP and later supporting a maintenance or inspection task with the Mobile Remote Servicer and the Flight Telerobotic Servicer is shown. Author

N88-21489*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
OPERATIONAL EXPERIENCE AND DESIGN RECOMMENDATIONS FOR TELEOPERATED FLIGHT HARDWARE c37
T. W. Burgess, D. P. Kuban (Oak Ridge National Lab., Tenn.), W. W. Hankins, and R. W. Mixon *In its* The 22nd Aerospace Mechanisms Symposium May 1988 p 287-305 (For primary document see N88-21468 14-39)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A18/MF A01 CSCL 13I

Teleoperation (remote manipulation) . will someday supplement/minimize astronaut extravehicular activity in space to perform such tasks as satellite servicing and repair, and space station construction and servicing. This technology is being investigated by NASA with teleoperation of two space-related tasks having been demonstrated at the Oak Ridge National Lab. The teleoperator experiments are discussed and the results of these experiments are summarized. The related equipment design recommendations are also presented. In addition, a general discussion of equipment design for teleoperation is also presented. Author

N88-21490*# Centre National d'Etudes Spatiales, Toulouse (France).
ROBOTIC JOINT EXPERIMENTS UNDER ULTRAVACUUM c37
A. Borrien and L. Petitjean *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 307-324 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 13I

First, various aspects of a robotic joint development program, including gearbox technology, electromechanical components, lubrication, and test results, are discussed. Secondly, a test prototype of the joint allowing simulation of robotic arm dynamic effects is presented. This prototype is tested under vacuum with different types of motors and sensors to characterize the functional parameters: angular position error, mechanical backlash, gearbox efficiency, and lifetime. Author

N88-21491*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION FULL-SCALE DOCKING/BERTHING MECHANISMS DEVELOPMENT c18
Gene C. Burns, Harold A. Price, and David B. Buchanan *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 325-340 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 22B

One of the most critical operational functions for the space station is the orbital docking between the station and the STS orbiter. The program to design, fabricate, and test docking/berthing mechanisms for the space station is described. The design reflects space station overall requirements and consists of two mating docking mechanism halves. One half is designed for use on the shuttle orbiter and incorporates capture and energy attenuation systems using computer controlled electromechanical actuators and/or attenuators. The mating half incorporates a flexible feature to allow two degrees of freedom at the module-to-module interface of the space station pressurized habitat volumes. The design concepts developed for the prototype units may be used for the first space station flight hardware. Author

N88-21492*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AMMONIA TRANSFER ACROSS ROTATING JOINTS IN SPACE c34
Mark H. Warner *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 341-353 (For primary document see N88-21468 14-39)
Avail: NTIS HC A18/MF A01 CSCL 20D

Thermal control of future large space facilities, such as the space station, will require the transfer of anhydrous ammonia across

rotating joints with near zero leakage. Anhydrous ammonia is the primary heat transfer fluid aboard the station, providing critical thermal management of habitat and payload systems. The solar radiator joints, as well as the various payload pointing systems, are obvious examples of the need for a reliable fluid transfer device. Low weight, tight temperature control, low parasitic drag torque, long life, and high reliability, in addition to near zero leakage, are important characteristics necessary for the successful operation of such a device. In late 1986, Lockheed initiated a project to develop a Rotary Transfer Coupling (RTC) directed toward space station requirements. Fabrication and assembly of this device is now complete and testing is scheduled. The design and development of the face seal-type rotary fluid coupling that utilizes a unique cover gas concept (an inert gas such as nitrogen) to provide full containment of the ammonia was addressed. Author

N88-21493*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DEVELOPMENT OF A ROTARY FLUID TRANSFER COUPLING AND SUPPORT MECHANISM FOR SPACE STATION c37

O. H. Bradley, Jr., J. A. Costulis, and A. H. Porter (PRC Kentron, Inc., Hampton, Va.) *In its* The 22nd Aerospace Mechanisms Symposium May 1988 p 355-371 (For primary document see N88-21468 14-39)

Avail: NTIS HC A18/MF A01 CSCL 13K

A design was developed for a rotary fluid coupling to transfer coolant fluids (primarily anhydrous ammonia) across rotating joints of the space station. Development testing using three conceptual designs yielded data which were used to establish the design of a multipass fluid coupling capable of handling three fluid circuits. In addition, a mechanism to support the fluid coupling and allow an astronaut to replace the coupling quickly and easily was designed. Author

N88-21494*# Lockheed Space Operations Co., Cocoa Beach, Fla.

ORBITER PROCESSING FACILITY SERVICE PLATFORM FAILURE AND REDESIGN c18

Jesse L. Harris *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 373-386 (For primary document see N88-21468 14-39)

Avail: NTIS HC A18/MF A01 CSCL 22B

In a high bay of the Orbiter Processing Facility (OPF) at the Kennedy Space Center, technicians were preparing the space shuttle orbiter Discovery for rollout to the Vehicle Assembly Building (VAB). A service platform, commonly referred to as an OPF Bucket, was being retracted when it suddenly fell, striking a technician and impacting Discovery's payload bay door. A critical component in the OPF Bucket hoist system had failed, allowing the platform to fall. The incident was thoroughly investigated by both NASA and Lockheed, revealing many design deficiencies within the system. The deficiencies and the design changes made to correct them are reviewed. Author

N88-21495*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE SHUTTLE SOLID ROCKET MOTOR PROFILE MEASURING DEVICE (PMD) c35

John Redmon *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 387-399 (For primary document see N88-21468 14-39)

Avail: NTIS HC A18/MF A01 CSCL 14B

The SRM PMD is an electromechanical tool used for measuring and recording the profile and diameters of the solid rocket motor segments, both Tang and Clevis ends. This system consists of a crossbeam assembly that mounts to the SRM segment using the existing assembly pin holes. The mounting configuration is such that the tool can be used to measure Clevis up/Tang down or Clevis up/Tang down. The testing and calibration of the PMD is described. Author

N88-21496*# Lockheed Space Operations Co., Cocoa Beach, Fla.

MODIFICATION AND DEVELOPMENT OF THE EXTERNAL TANK HYDROGEN VENT UMBILICAL SYSTEM FOR THE SPACE SHUTTLE VEHICLE c16

Bemis C. Tatem, Jr. *In* NASA. Langley Research Center, The 22nd Aerospace Mechanisms Symposium May 1988 p 401-410 (For primary document see N88-21468 14-39)

Avail: NTIS HC A18/MF A01 CSCL 22B

The design and development of a new T-O lock and secondary release mechanism which is being introduced to the ET Hydrogen Vent Umbilical System for the next launch of the Space Shuttle Vehicle is described. Critical analysis of the system in early 1986 indicated the need for an improvement in the secondary release system. The new T-O lock increases the clearance with the vehicle during secondary disconnect and is described. Author

N88-21497*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A VISCOPLASTIC THEORY APPLIED TO COPPER

Alan D. Freed and Michael J. Verrilli 1988 15 p Proposed for presentation at the International Seminar on the Inelastic Behavior of Solids Models and Utilization, Besancon, France, 30 Aug. - 1 Sep. 1988; sponsored by MECAMAT

(NASA-TM-100831; E-4020; NAS 1.15:100831) Avail: NTIS HC A03/MF A01 CSCL 20K

A phenomenologically based viscoplastic model is derived for copper. The model is thermodynamically constrained by the condition of material dissipativity. Two internal state variables are considered. The back stress accounts for strain-induced anisotropy, or kinematic hardening. The drag stress accounts for isotropic hardening. Static and dynamic recovery terms are not coupled in either evolutionary equation. The evolution of drag stress depends on static recovery, while the evolution of back stress depends on dynamic recovery. The material constants are determined from isothermal data. Model predictions are compared with experimental data for thermomechanical test conditions. They are in good agreement at the hot end of the loading cycle, but the model overpredicts the stress response at the cold end of the cycle. Author

N88-21498*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NONLINEAR CONSTITUTIVE RELATIONS FOR HIGH TEMPERATURE APPLICATIONS, 1986

Apr. 1988 482 p Symposium held in Akron, Ohio, 11-13 Jun. 1986; sponsored by NASA, Lewis Research Center, Cleveland, Ohio and Akron Univ., Ohio

(NASA-CP-10010; E-3956; NAS 1.55:10010) Avail: NTIS HC A21/MF A01 CSCL 20K

The purpose of the symposium was to review the state-of-the-art in nonlinear constitutive modeling of high temperature materials for aeronautics applications and to identify the need for future research and development efforts in this area. Through this symposium, it was recognized that considerable research efforts are urgently needed in the development of nonlinear constitutive relations for high temperature applications. In the aerospace industry this need is further prompted by recent advances in high temperature materials technology and new demands on material and component performance. For individual titles, see N88-21499 through N88-21527.

N88-21499*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.

THE VISCOPLASTICITY THEORY BASED ON OVERSTRESS APPLIED TO THE MODELING OF A NICKEL BASE SUPERALLOY AT 815 C c26

E. Krempl, H. Lu, and D. Yao *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 1-5 (For primary document see N88-21498 14-39)

Avail: NTIS HC A21/MF A01 CSCL 11F

Short term strain rate change, creep and relaxation tests were performed in an MTS computer controlled servohydraulic testing machine. Aging and recovery were found to be insignificant for test times not exceeding 30 hrs. The material functions and constants of the theory were identified from results of strain rate change tests. Numerical integration of the theory for relaxation and creep tests showed good predictive capabilities of the viscoplasticity theory based on overstress. Author

N88-21500*# Akron Univ., Ohio.
A VISCOPLASTIC CONSTITUTIVE THEORY FOR METAL MATRIX COMPOSITES AT HIGH TEMPERATURE **c24**
David N. Robinson, Stephen F. Duffy (Cleveland State Univ., Ohio.), and John R. Ellis *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 7-25 Previously announced as N87-13790 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11D

A viscoplastic constitutive theory is presented for representing the high temperature deformation behavior of metal matrix composites. The point of view taken is a continuum one where the composite is considered a material in its own right, with its own properties that can be determined for the composite as a whole. It is assumed that a single preferential (fiber) direction is identifiable at each material point (continuum element) admitting the idealization of local transverse isotropy. A key ingredient is the specification of an experimental program for the complete determination of the material functions and parameters for characterizing a particular metal matrix composite. The parameters relating to the strength of anisotropy can be determined through tension/torsion tests on longitudinally and circumferentially reinforced thin walled tubes. Fundamental aspects of the theory are explored through a geometric interpretation of some basic features analogous to those of the classical theory of plasticity. Author

N88-21501*# General Electric Co., Cincinnati, Ohio.
DEVELOPMENT OF A UNIFIED CONSTITUTIVE MODEL FOR AN ISOTROPIC NICKEL BASE SUPERALLOY RENE 80 **c26**
V. G. Ramaswamy, R. H. VanStone, J. H. Laflen, and D. C. Stouffer (Cincinnati Univ., Ohio.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 27-35 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

Accurate analysis of stress-strain behavior is of critical importance in the evaluation of life capabilities of hot section turbine engine components such as turbine blades and vanes. The constitutive equations used in the finite element analysis of such components must be capable of modeling a variety of complex behavior exhibited at high temperatures by cast superalloys. The classical separation of plasticity and creep employed in most of the finite element codes in use today is known to be deficient in modeling elevated temperature time dependent phenomena. Rate dependent, unified constitutive theories can overcome many of these difficulties. A new unified constitutive theory was developed to model the high temperature, time dependent behavior of Rene' 80 which is a cast turbine blade and vane nickel base superalloy. Considerations in model development included the cyclic softening behavior of Rene' 80, rate independence at lower temperatures and the development of a new model for static recovery. Author

N88-21502*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
MODELING THE VISCOPLASTIC BEHAVIOR OF INCONEL 718 AT 1200 F **c26**
M. S. Abdel-Kader (Military Technical Coll., Cairo, Egypt), J. Eftis, and D. L. Jones *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 37-68 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

A large number of tests, including tensile, creep, fatigue, and creep-fatigue were performed to characterize the mechanical properties of Inconel 718 (a nickel based superalloy) at 1200 F, the operating temperature for turbine blades. In addition, a few attempts were made to model the behavior of Inconel 718 at 1200 F using viscoplastic theories. The Chaboche theory of viscoplasticity can model a wide variety of mechanical behavior, including monotonic, sustained, and cyclic responses of homogeneous, initially-isotropic, strain hardening (or softening) materials. It is shown how the Chaboche theory can be used to model the viscoplastic behavior of Inconel 718 at 1200 F. First, an algorithm was developed to systematically determine the material parameters of the Chaboche theory from uniaxial tensile, creep, and cyclic data. The algorithm is general and can be used in conjunction with similar high temperature materials. A sensitivity study was then performed and an optimal set of Chaboche's parameters were obtained. This study has also indicated the role of each parameter in modeling the response to different loading conditions. Author

N88-21503*# Massachusetts Inst. of Tech., Cambridge.
AN INTERNAL VARIABLE CONSTITUTIVE MODEL FOR THE LARGE DEFORMATION OF METALS AT HIGH TEMPERATURES **c26**
Stuart Brown and Lallit Anand *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 69-75 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

The advent of large deformation finite element methodologies is beginning to permit the numerical simulation of hot working processes whose design until recently has been based on prior industrial experience. Proper application of such finite element techniques requires realistic constitutive equations which more accurately model material behavior during hot working. A simple constitutive model for hot working is the single scalar internal variable model for isotropic thermal elastoplasticity proposed by Anand. The model is recalled and the specific scalar functions, for the equivalent plastic strain rate and the evolution equation for the internal variable, presented are slight modifications of those proposed by Anand. The modified functions are better able to represent high temperature material behavior. The monotonic constant true strain rate and strain rate jump compression experiments on a 2 percent silicon iron is briefly described. The model is implemented in the general purpose finite element program ABAQUS. Author

N88-21504*# Ljubljana Univ. (Yugoslavia). Dept. of Mechanical Engineering.
PRESSURE INDUCED AGEING OF POLYMERS **c27**
I. Emri and W. G. Knauss (California Inst. of Tech., Pasadena.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 77-88 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11C

The nonlinearly viscoelastic response of an amorphous homopolymer is considered under aspects of time dependent free volume behavior. In contrast to linearly viscoelastic solids, this model couples shear and volume deformation through a shift function which influences the rate of molecular relaxation or creep. Sample computations produce all those qualitative features one observes normally in uniaxial tension including the rate dependent formation of a yield point as a consequence of the history of an imposed pressure. Author

N88-21505*# Rensselaer Polytechnic Inst., Troy, N.Y.
A SIMPLIFIED ORTHOTROPIC FORMULATION OF THE VISCOPLASTICITY THEORY BASED ON OVERSTRESS
M. Sutcu and E. Krempl *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 89-95 Previously announced as N88-70180 Sponsored in part by NSF (For primary document see N88-21498 14-39)

(Grant NAG3-262)
Avail: NTIS HC A21/MF A01 CSCL 20K

An orthotropic, small strain viscoplasticity theory based on overstress is presented. In each preferred direction the stress is composed of time (rate) independent (or plastic) and viscous (or rate dependent) contributions. Tension-compression asymmetry can depend on direction and is included in the model. Upon a proper choice of a material constant one preferred direction can exhibit linear elastic response while the other two deform in a viscoplastic manner. Author

N88-21506*# Rochester Inst. of Tech., N. Y.
CONSTITUTIVE MODELING AND THERMOVISCOPLASTICITY
Richard B. Hetnarski, Hany Ghoneim, and Donald B. Paul (Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 97-107 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

Development and solution of coupled thermomechanical equations at elevated temperature and/or high strain rates are discussed. Three main considerations are presented: development of the coupled thermomechanical equations by means of the rational theory of thermodynamics, development of a thermoviscoplastic constitutive equation which is congruous with the developed coupled equations, and the applicability of the developed equations to the treatment by the finite element method. Author

N88-21507*# Oak Ridge National Lab., Tenn. Heavy-Section Steel Technology Program.
APPLICATIONS OF ELASTIC-VISCOPLASTIC CONSTITUTIVE MODELS IN DYNAMIC ANALYSES OF CRACK RUN-ARREST EVENTS
B. R. Bass, C. E. Pugh, and R. W. Swindeman *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 109-117 Previously announced as N87-18904 (For primary document see N88-21498 14-39)
(NRC-40-551-75; NRC-40-552-75; DE-AC05-84OR-21400)
Avail: NTIS HC A21/MF A01 CSCL 20K

Applications of nonlinear techniques to the first series of six HSST wide-plate crack-arrest tests that were performed are described. The experiments include crack initiations at low temperatures and relatively long (20 cm) cleavage propagation phases which are terminated by arrest in high temperature regions. Crack arrest are then followed by ductile tearing events. Consequently, the crack front regions are exposed to wide ranges of strain rates and temperatures. E.R.

N88-21508*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A THEORY OF VISCOPLASTICITY ACCOUNTING FOR INTERNAL DAMAGE
A. D. Freed and D. N. Robinson (Akron Univ., Ohio.) *In its* Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 119-136 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

A constitutive theory for use in structural and durability analyses of high temperature isotropic alloys is presented. Constitutive equations based upon a potential function are determined from conditions of stability and physical considerations. The theory is self-consistent; terms are not added in an ad hoc manner. It extends a proven viscoplastic model by introducing the Kachanov-Rabotnov concept of net stress. Material degradation and inelastic deformation are unified; they evolve simultaneously and interactively. Both isotropic hardening and material degradation evolve with dissipated work which is the sum of inelastic work and internal work. Internal work is a continuum measure of the stored free energy resulting from inelastic deformation. Author

N88-21509*# Oakland Univ., Rochester, Mich.
CREEP RUPTURE ANALYSIS OF A BEAM RESTING ON HIGH TEMPERATURE FOUNDATION
Randy J. Gu and Francis A. Cozzarelli (State Univ. of New York, Buffalo.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 137-185 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

A simplified uniaxial strain controlled creep damage law is deduced with the use of experimental observation from a more complex strain dependent law. This creep damage law correlates the creep damage, which is interpreted as the density variation in the material, directly with the accumulated creep strain. Based on the deduced uniaxial strain controlled creep damage law, a continuum mechanical creep rupture analysis is carried out for a beam resting on a high temperature elastic (Winkler) foundation. The analysis includes the determination of the nondimensional time for initial rupture, the propagation of the rupture front with the associated thinning of the beam, and the influence of creep damage on the deflection of the beam. Creep damage starts accumulating in the beam as soon as the load is applied, and a creep rupture front develops at and propagates from the point at which the creep damage first reaches its critical value. By introducing a series of fundamental assumptions within the framework of technical Euler-Bernoulli type beam theory, a governing set of integro-differential equations is derived in terms of the nondimensional bending moment and the deflection. These governing equations are subjected to a set of interface conditions at the propagating rupture front. A numerical technique is developed to solve the governing equations together with the interface equations, and the computed results are presented and discussed in detail. Author

N88-21510*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering and Engineering Mechanics.
A CONSTITUTIVE MODEL WITH DAMAGE FOR HIGH TEMPERATURE SUPERALLOYS c26
J. A. Sherwood and D. C. Stouffer *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 187-200 Sponsored in part by AF (For primary document see N88-21498 14-39)
(Grant NAG3-511)
Avail: NTIS HC A21/MF A01 CSCL 11F

A unified constitutive model is searched for that is applicable for high temperature superalloys used in modern gas turbines. Two unified inelastic state variable constitutive models were evaluated for use with the damage parameter proposed by Kachanov. The first is a model (Bodner, Partom) in which hardening is modeled through the use of a single state variable that is similar to drag stress. The other (Ramaswamy) employs both a drag stress and back stress. The extension was successful for predicting the tensile, creep, fatigue, torsional and nonproportional response of Rene' 80 at several temperatures. In both formulations, a cumulative damage parameter is introduced to model the changes in material properties due to the formation of microcracks and microvoids that ultimately produce a macroscopic crack. A back stress/drag stress/damage model was evaluated for Rene' 95 at 1200 F and is shown to predict the tensile, creep, and cyclic loading responses reasonably well. Author

N88-21511*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF STRUCTURAL ANALYSIS METHODS FOR LIFE PREDICTION
A. Kaufman, J. F. Saltsman, G. R. Halford, and M. Tong (Sverdrup Technology, Inc., Cleveland, Ohio.) *In its* Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 201-216 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

The utility of advanced constitutive models and structural analysis methods are evaluated for predicting the cyclic life of an air-cooled turbine blade for a gas turbine aircraft engine. Structural analysis methods of various levels of sophistication were exercised

to obtain the cyclic stress-strain response at the critical airfoil location. Calculated strain ranges and mean stresses from the stress-strain cycles were used to predict crack initiation lives by using the total strain version of the strain range partitioning life prediction method. The major results are given and discussed.
Author

N88-21512*# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
DATA REQUIREMENTS TO MODEL CREEP IN 9Cr-1Mo-V STEEL **c26**
R. W. Swindeman *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 217-223 Previously announced as N87-12944 (For primary document see N88-21498 14-39)
(Contract DE-AC05-84OR-21400)
Avail: NTIS HC A21/MF A01 CSCL 11F

Models for creep behavior are helpful in predicting response of components experiencing stress redistributions due to cyclic loads, and often the analyst would like information that correlates strain rate with history assuming simple hardening rules such as those based on time or strain. On the one hand, much progress has been made in the development of unified constitutive equations that include both hardening and softening through the introduction of state variables whose evolutions are history dependent. Although it is difficult to estimate specific data requirements for general application, there are several simple measurements that can be made in the course of creep testing and results reported in data bases. The issue is whether or not such data could be helpful in developing unified equations, and, if so, how should such data be reported. Data produced on a martensitic 9Cr-1Mo-V-Nb steel were examined with these issues in mind. Author

N88-21513*# Washington State Univ., Pullman. Dept. of Mechanical Engineering.
CONTROLLED-STRAIN RATE TESTS AT VERY LOW STRAIN RATES OF 2618 ALUMINUM AT 200 C **c26**
J. L. Ding and S. R. Lee *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 225-238 (For primary document see N88-21498 14-39)
(Grant NSF MEA-84-029)
Avail: NTIS HC A21/MF A01 CSCL 11F

Constant strain rate tests and constant load creep tests were performed on 2618 aluminum at 200 C. The strain rates used in the constant strain rate tests were 10 to the minus 6, 10 to the minus 7, 10 to the minum 8, and 10 to the minus 9/sec. Due to the fact that the strain rates in both tests were comparable to each other, the similarities between them can therefore be studied. It was concluded that metals are essentially rate sensitive at elevated temperatures. The traditional definition of creep and plasticity used in the classical creep analysis is actually a reflection of the material behavior under different loading conditions. A constitutive equation based on the test data under one loading condition should work well for other loading conditions as long as the strain rates are in the same range as those under which the material constants are determined. Author

N88-21514*# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering and Mechanics.
CYCLIC UNIAXIAL AND BIAXIAL HARDENING OF TYPE 304 STAINLESS STEEL MODELED BY THE VISCOPLASTICITY THEORY BASED ON OVERSTRESS **c26**
David Yao and Erhard Krempl *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 239-245 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

The isotropic theory of viscoplasticity based on overstress does not use a yield surface or a loading and unloading criterion. The inelastic strain rate depends on overstress, the difference between the stress and the equilibrium stress, and is assumed to be rate dependent. Special attention is paid to the modeling of elastic regions. For the modeling of cyclic hardening, such as observed in annealed Type 304 stainless steel, and additional growth law for a scalar quantity which represents the rate independent asymptotic value of the equilibrium stress is added. It is made to increase with inelastic deformation using a new scalar measure which differentiates between nonproportional and proportional loading. The theory is applied to correlate uniaxial data under two step amplitude loading including the effect of further hardening at the high amplitude and proportional and nonproportional cyclic loadings. Results are compared with corresponding experiments.
Author

N88-21515*# Georgia Inst. of Tech., Atlanta. School of Mechanical Engineering.
SOME IMPLICATIONS FOR CYCLIC PLASTIC AND VISCOPLASTIC EQUATIONS BASED ON NONPROPORTIONAL LOADING EXPERIMENTS
D. L. McDowell, J. Moosbrugger, M. Doumi, and E. H. Jordan (Connecticut Univ., Storrs.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 247-252 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

From cyclic, strain controlled, nonproportional tests on type 304 stainless steel and Hastelloy-X, the following statements may be made: (1) A dynamic recovery term is essential to properly model the backstress evolution. (2) From analysis of Hastelloy-X data obtained at 649 C, the inelastic strain rate appears to be a satisfactory directional index for direct hardening, but the backstress appears to be an inappropriate directional index of dynamic recovery. (3) Sinusoidal, 90 deg out-of-phase axial torsional tests can be very useful in aiding determination of backstress evolution functions, including both directional indices and scalar hardening functions, by virtue of the associated approximately constant magnitudes of overstress, inelastic strain rate, and effective stress. Such tests have previously been associated with the study of nonproportional hardening effects but have more far ranging applications. Author

N88-21516*# Texas A&M Univ., College Station.
AN EXPERIMENTAL COMPARISON OF SEVERAL CURRENT VISCOPLASTIC CONSTITUTIVE MODELS AT ELEVATED TEMPERATURE
G. H. James, P. K. Imbrie, P. S. Hill, D. H. Allen, and W. E. Haisler *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 253-289 Previously announced in IAA as A87-40508 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

Four current viscoplastic models are compared experimentally for Inconel 718 at 593 C. This material system responds with apparent negative strain rate sensitivity, undergoes cyclic work softening, and is susceptible to low cycle fatigue. A series of tests were performed to create a data base from which to evaluate material constants. A method to evaluate the constants is developed which draws on common assumptions for this type of material, recent advances by other researchers, and iterative techniques. A complex history test, not used in calculating the constants, is then used to compare the predictive capabilities of the models. The combination of exponentially based inelastic strain rate equations and dynamic recovery is shown to model this material system with the greatest success. The method of constant calculation developed was successfully applied to the complex material response encountered. Backstress measuring tests were found to be invaluable and to warrant further development.
Author

N88-21517*# Georgia Inst. of Tech., Atlanta. Fracture and Fatigue Research Lab.
THE EFFECTS OF TEMPERATURE AND STRAIN RATE ON THE YIELDING BEHAVIOR OF THE SINGLE CRYSTAL SUPERALLOY PWA 1480 **c26**

Walter W. Milligan and Stephen D. Antolovich *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 291-294 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 11F

Interrupted tensile tests were conducted on (001) oriented single crystals at temperatures from 20 to 1093 C. Two strain rates were used, 0.5 and 50 percent/min. After the tests, the deformation substructures were characterized by transmission electron microscopy. Results of these tests are given. Author

N88-21518*# Illinois Univ., Urbana-Champaign. Dept. of Mechanical and Industrial Engineering.
A UNIFIED CREEP-PLASTICITY MODEL SUITABLE FOR THERMO-MECHANICAL LOADING
D. Slavik and H. Sehitoglu *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 295-306 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

An experimentally based unified creep-plasticity constitutive model was implemented for 1070 steel. Accurate rate and temperature effects were obtained for isothermal and thermo-mechanical loading by incorporating deformation mechanisms into the constitutive equations in a simple way. Author

N88-21519*# Akron Univ., Ohio. Dept. of Civil Engineering.
ON THE GLOBAL/LOCAL TIME INCREMENTING FOR VISCOPLASTIC ANALYSIS
A. F. Saleeb, T. Y. Chang, and J. Y. Chen *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 307-315 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

A global/local time incrementing scheme for viscoplastic analysis of structures is presented. The scheme is very efficient and useful for conducting large scale nonlinear finite element analysis involving viscoplastic materials. Author

N88-21520*# Texas A&M Univ., College Station.
AN AUTOMATED PROCEDURE FOR MATERIAL PARAMETER EVALUATION FOR VISCOPLASTIC CONSTITUTIVE MODELS
P. K. Imbrie, G. H. James, P. S. Hill, D. H. Allen, and W. E. Haisler *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 317-352 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

An automated procedure is presented for evaluating the material parameters in Walker's exponential viscoplastic constitutive model for metals at elevated temperature. Both physical and numerical approximations are utilized to compute the constants for Inconel 718 at 1100 F. When intermediate results are carefully scrutinized and engineering judgement applied, parameters may be computed which yield stress output histories that are in agreement with experimental results. A qualitative assessment of the theta-plot method for predicting the limiting value of stress is also presented. The procedure may also be used as a basis to develop evaluation schemes for other viscoplastic constitutive theories of this type. Author

N88-21521*# Connecticut Univ., Storrs.
A CONSTITUTIVE MATERIAL MODEL FOR NONLINEAR FINITE ELEMENT STRUCTURAL ANALYSIS USING AN ITERATIVE MATRIX APPROACH
Herbert A. Koenig, Kwai S. Chan, Brice N. Cassenti, and Richard Weber (Pratt and Whitney Aircraft, East Hartford, Conn.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 353-357 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

A unified numerical method for the integration of stiff time dependent constitutive equations is presented. The solution process is directly applied to a constitutive model proposed by Bodner. The theory confronts time dependent inelastic behavior coupled with both isotropic hardening and directional hardening behaviors. Predicted stress-strain responses from this model are compared to experimental data from cyclic tests on uniaxial specimens. An algorithm is developed for the efficient integration of the Bodner flow equation. A comparison is made with the Euler integration method. An analysis of computational time is presented for the three algorithms. Author

N88-21522*# Pratt and Whitney Aircraft, East Hartford, Conn.
NONLINEAR STRUCTURAL ANALYSIS OF A TURBINE AIRFOIL USING THE WALKER VISCOPLASTIC MATERIAL MODEL FOR B1900 + Hf
T. G. Meyer, J. T. Hill, and R. M. Weber *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 359-369 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

A viscoplastic material model for the high temperature turbine airfoil material B1900 + Hf was developed and was demonstrated in a three dimensional finite element analysis of a typical turbine airfoil. The demonstration problem is a simulated flight cycle and includes the appropriate transient thermal and mechanical loads typically experienced by these components. The Walker viscoplastic material model was shown to be efficient, stable and easily used. The demonstration is summarized and the performance of the material model is evaluated. Author

N88-21523*# Southwest Research Inst., San Antonio, Tex.
UNIFIED CONSTITUTIVE MODELS FOR HIGH-TEMPERATURE STRUCTURAL APPLICATIONS
U. S. Lindholm, K. S. Chan, S. R. Bodner, R. M. Weber, and K. P. Walker (Engineering Science Software, Inc., Smithfield, R.I.) *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 371-394 (For primary document see N88-21498 14-39)
(Contract NAS3-23925)
Avail: NTIS HC A21/MF A01 CSCL 20K

Unified constitutive models are characterized by the use of a single inelastic strain rate term for treating all aspects of inelastic deformation, including plasticity, creep, and stress relaxation under monotonic or cyclic loading. The structure of this class of constitutive theory pertinent for high temperature structural applications is first outlined and discussed. The effectiveness of the unified approach for representing high temperature deformation of Ni-base alloys is then evaluated by extensive comparison of experimental data and predictions of the Bodner-Partom and the Walker models. The use of the unified approach for hot section structural component analyses is demonstrated by applying the Walker model in finite element analyses of a benchmark notch problem and a turbine blade problem. Author

N88-21524*# General Electric Co., Cincinnati, Ohio.
CONSTITUTIVE RESPONSE OF RENE 80 UNDER THERMAL MECHANICAL LOADS
K. S. Kim, T. S. Cook, and R. L. McKnight *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 395-418 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

The applicability of a classical constitutive model for stress-strain analysis of a nickel base superalloy, Rene' 80, in the gas turbine thermomechanical fatigue (TMF) environment is examined. A variety of tests were conducted to generate basic material data and to investigate the material response under cyclic thermomechanical loading. Isothermal stress-strain data were acquired at a variety of strain rates over the TMF temperature range. Creep curves were examined at 2 temperature ranges, 871 to 982 C and 760 to 871 C. The results provide optimism on the ability of the classical constitutive model for high temperature applications. Author

N88-21525*# Pratt and Whitney Aircraft, East Hartford, Conn.
A CONSTITUTIVE MODEL FOR AN OVERLAY COATING c27
D. M. Nissley and G. A. Swanson *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 419-436 (For primary document see N88-21498 14-39)
(Contract NAS3-23939)
Avail: NTIS HC A21/MF A01 CSCL 11C

Coatings are frequently applied to gas turbine blades and vanes to provide protection against oxidation and corrosion. The results of an experimental and analytical study to develop a constitutive model for an overlay coating is presented. Specimens were machined from a hot isostatically pressed billet of PWA 286. The tests consisted of isothermal stress relaxation cycles with monotonically increasing maximum strain and were conducted at various temperatures. The results were used to calculate the constants for various constitutive models, including the classical, the Walker isotropic, a simplified Walker, and Stowell models. A computerized regression analysis was used to calculate model constants from the data. The best fit was obtained for the Walker model, with the simplified Walker and classical models close behind. Author

N88-21526*# Georgia Inst. of Tech., Atlanta. School of Engineering Science and Mechanics.
NON-ISOTHERMAL ELASTOVISCOPLASTIC ANALYSIS OF PLANAR CURVED BEAMS
G. J. Simitses, R. L. Carlson, and R. Riff *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 437-459 (For primary document see N88-21498 14-39)
(Grant NAG3-54)
Avail: NTIS HC A21/MF A01 CSCL 20K

The development of a general mathematical model and solution methodologies, to examine the behavior of thin structural elements such as beams, rings, and arches, subjected to large nonisothermal elastoviscoplastic deformations is presented. Thus, geometric as well as material type nonlinearities of higher order are present in the analysis. For this purpose a complete true abinito rate theory of kinematics and kinetics for thin bodies, without any restriction on the magnitude of the transformation is presented. A previously formulated elasto-thermo-viscoplastic material constitutive law is employed in the analysis. The methodology is demonstrated through three different straight and curved beams problems. Author

N88-21527*# Akron Univ., Ohio.
EFFECTS OF STATE RECOVERY ON CREEP BUCKLING UNDER VARIABLE LOADING
D. N. Robinson and S. M. Arnold *In* NASA. Lewis Research Center, Nonlinear Constitutive Relations for High Temperature Applications, 1986 Apr. 1988 p 461-489 Previously announced as N86-25310 (For primary document see N88-21498 14-39)
Avail: NTIS HC A21/MF A01 CSCL 20K

Structural alloys embody internal mechanisms that allow recovery of state with varying stress and elevated temperature, i.e., they can return to a softer state following periods of hardening. Such material behavior is known to strongly influence structural response under some important thermomechanical loadings, for example, that involving thermal ratchetting. The influence of dynamic and thermal recovery on the creep buckling of a column under variable loading is investigated. The column is taken as the idealized (Shanley) sandwich column. The constitutive model, unlike the commonly employed Norton creep model, incorporates a representation of both dynamic and thermal (state) recovery. The material parameters of the constitutive model are chosen to characterize Narloy Z, a representative copper alloy used in thrust nozzle liners of reusable rocket engines. Variable loading histories include rapid cyclic unloading/reloading sequences and intermittent reductions of load for extended periods of time; these are superimposed on a constant load. The calculated results show that state recovery significantly affects creep buckling under variable loading. Author

N88-21528# State Univ. of New York, Buffalo. National Center for Earthquake Engineering Research.
PRACTICAL CONSIDERATIONS FOR STRUCTURAL CONTROL: SYSTEM UNCERTAINTY, SYSTEM TIME DELAY AND TRUNCATION OF SMALL CONTROL FORCES
J. N. Yang and A. Akbarpour 10 Aug. 1987 159 p Prepared in cooperation with George Washington Univ., Washington, D.C.
(Grants NSF ECE-86-07591; NSF ECE-85-21496)
(PB88-163738; NCEER-87-0018) Avail: NTIS HC A08/MF A01 CSCL 20K

For practical application of structural control system, various important factors should be considered, including the system time delay, uncertainty in structural identification, and truncation of small control forces. A sensitivity study was conducted to investigate the effects of these factors on the control system of structures. The influence of system time delay, estimation errors for structural parameters, and elimination of small control forces on the efficiency of the control system depends upon the particular control algorithm used. Four control algorithms practical for applications to earthquake-excited structures were studied. These include the Ricatti closed-loop control algorithm and three instantaneous optimal control algorithms recently proposed. The methodologies for the sensitivity analysis are presented. Both the active tendon control system and the active mass damper were considered. Numerical examples are worked out to demonstrate the criticality and tolerance of these factors for practical implementation of active control systems. GRA

N88-21529# State Univ. of New York, Buffalo. National Center for Earthquake Engineering Research.
NONSTATIONARY SOLUTION IN RANDOM VIBRATION THEORY
J. R. Red-Horse and P. D. Spanos 3 Nov. 1987 41 p Prepared in cooperation with Rice Univ., Houston, Tex.
(Grant NSF ECE-86-07591)
(PB88-163746; NCEER-87-0020) Avail: NTIS HC A03/MF A01 CSCL 20K

An approximate Markov process for a function of the system response of a class of highly damped, nonlinear random vibration problems is derived using the method of stochastic averaging. The solution of the associated forward Kolmogorov equation for the transition probability density function is presented. The merit of the solution is demonstrated by deriving the spectral density of the system stationary response to step modulated white noise. The reliability of the results is assessed by performing appropriate Monte Carlo simulations. GRA

N88-21530# Technische Hogeschool Twente, Enschede (Netherlands).
SIMULATION OF THERMO-MECHANICAL FORMING PROCESSES: A MIXED EULERIAN-LANGRANGIAN FINITE ELEMENT METHOD Ph.D. Thesis
H. Huetink 1986 154 p
(PB88-155247) Avail: NTIS HC A08/MF A01 CSCL 20K

A formulation of elastic-plastic constitutive equations is given based on principles of continuum thermo-mechanics and thermodynamics. Energy dissipation and phase changes are included in the mathematical model. It is shown that kinematic hardening can be described properly for large deformations, by a two-fractions model. A mixed Eulerian-Lagrangian finite element method was developed by which nodal point locations may be adapted independently of the material displacement. Applications are shown by simulations of an upsetting process, a wire drawing process and a steel quenching process. The results of the simulation of the upsetting process show satisfactory agreement with the results of an experiment carried out. GRA

N88-21531# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (West Germany).
INVESTIGATION OF THE COMPONENTS OF THE ENERGY-MOMENTUM TENSOR IN THE NEIGHBORHOOD OF CRACK TIPS UNDER SPECIAL MATERIALS AND LOADING CONDITIONS [UNTERSUCHUNG DER KOMPONENTEN DES ENERGIE-IMPULS-TENSORS IN DER UMGEBUNG VON RISSPITZEN UNTER SPEZIELLEN MATERIAL- UND BEANSPRUCHUNGSBEDINGUNGEN]
S. Siegele Mar. 1987 127 p In GERMAN
(Contracts DFG-Schm-522/5-1; FhG-204-072)
(W-4/87; ETN-88-91463) Avail: NTIS HC A07/MF A01

The suitability of the energy-momentum tensor in the near field of cracks under superposed normal and shear loading and linear-elastic and elastoplastic materials behavior, for the determination of fracture hypotheses was investigated. Based on fracture-mechanical formulations of the loading in the crack tip domain, existing and deduced fracture hypotheses were determined and their predictions compared. It is shown that the local fracture criterion in a side-axis system, in which the diagonal elements of the tensor disappear, gives nearly the same result for the fracture deviation angle as the tangential stress hypothesis. The stresses occurring in the range of a crack tip, as well as the components of the energy-momentum tensor and the energy release rate were calculated using the finite element method, and compared with the analytically calculated values of the tensor, showing good agreement. ESA

N88-21532# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (West Germany).
INVESTIGATION OF THE BEHAVIOR OF FAST PROPAGATING CRACKS USING NUMERICAL SIMULATION CALCULATIONS [UNTERSUCHUNG DES VERHALTENS SCHNELL LAUFENDER RISSE MIT HILFE NUMERISCHER SIMULATIONSRECHNUNGEN]
M. Windisch Mar. 1987 110 p In GERMAN
(Contracts DFG-Schm-522/4-2; FhG-204-080)
(W-6/87; ETN-88-91465) Avail: NTIS HC A06/MF A01

The dynamic behavior of the single edge notch (SEN) sample was numerically simulated and analyzed using the finite difference method. Using the equilibrium state as initial condition and the experimentally determined crack growth curves from 12 tests, the simulation program provides a relation between fracture velocity and stress factor, in agreement with the experimental results of the shadow-optical evaluation. This relation allows the simulation of dynamic crack propagation with modified parameters without experimental data, as well as the observation of effects which were not determined by the tests. The results of the simulation agree with those of other investigations. ESA

N88-21533# Newcastle-upon-Tyne Univ. (England). Dept. of Metallurgy and Engineering Materials.
EFFECT OF LOADING CONDITIONS ON ENVIRONMENT-SENSITIVE FRACTURE Final Report
K. Ebtehaj, D. Hardie, and R. N. Parkins May 1987 91 p
(Contract MOD-D/ER1/9/4/2043/082)
(BR102697; ETN-88-91912) Avail: NTIS HC A05/MF A01

The mechanical and environmental requirements for stress corrosion cracking of 6082, 6061, 5083, and 7019 aluminum alloys, in all cases in the as-received condition, i.e., no additional heat treatment was employed, were investigated. All the alloys except 6061 slowly strained in laboratory air undergo ductile failure, but 6061 alloy is susceptible to a form of intergranular creep cracking at room temperature. All the alloys (including 6061) have secondary cracks after straining. This nonenvironmental cracking is associated with secondary phases present in the alloys. Polarization of tensile specimens at -250 mV(sce) in tap water, prior to straining in tap water under open circuit conditions, leads to significant reduction of ductility, but recovery of ductility occurs as the applied strain rate is decreased. Straining in sea water at controlled potentials reveals severe cracking in all the alloys at potentials either above -750 mV(sce) or below -1400 mV(sce). ESA

N88-21534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TEST FACILITIES OF THE STRUCTURAL DYNAMICS BRANCH OF NASA LEWIS RESEARCH CENTER
Gerald T. Montague (Sverdrup Technology, Inc., Cleveland, Ohio.) and Robert E. Kielb May 1988 26 p
(NASA-TM-100800; E-3978; NAS 1.15:100800) Avail: NTIS HC A03/MF A01 CSCL 20K

The NASA Lewis Research Center Structural Dynamics Branch conducts experimental and analytical research related to the structural dynamics of aerospace propulsion and power systems. The experimental testing facilities of the branch are examined. Presently there are 10 research rigs and 4 laboratories within the branch. These facilities are described along with current and past research work. Author

N88-21535*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Engineering Dept.
ON 3-D INELASTIC ANALYSIS METHODS FOR HOT SECTION COMPONENTS. VOLUME 1: SPECIAL FINITE ELEMENT MODELS Annual Report No. 4, 14 Feb. 1986 - 14 Feb. 1987
S. Nakazawa May 1988 81 p Original contains color illustrations
(Contract NAS3-23697)
(NASA-CR-180893; NAS 1.26:180893; PWA-5940-62-Vol-1)
Avail: NTIS HC A05/MF A01 CSCL 20K

This annual status report presents the results of work performed during the fourth year of the 3-D Inelastic Analysis Methods for Hot Section Components program (NASA Contract NAS3-23697). The objective of the program is to produce a series of new computer codes permitting more accurate and efficient 3-D analysis of selected hot section components, i.e., combustor liners, turbine blades and turbine vanes. The computer codes embody a progression of math models and are streamlined to take advantage of geometrical features, loading conditions, and forms of material response that distinguish each group of selected components. Volume 1 of this report discusses the special finite element models developed during the fourth year of the contract. Author

N88-21266# Joint Publications Research Service, Arlington, Va.
OPTIMAL FILAMENT SHELLS LOADED WITH INTERNAL PRESSURE IN A CENTRIFUGAL FORCE FIELD Abstract Only
S. B. Cherevatskiy, V. M. Kotlyar, and S. G. Sidorin *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 24 Transl. into ENGLISH from Mekhanika Kompozitnykh Materialov (Riga, USSR), no. 5, Sep. - Oct. 1986 p 859-864 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21335# Joint Publications Research Service, Arlington, Va.
THE USE OF PHOTOELASTIC METHODS TO STUDY THE STRESSED STATES OF SPOT-WELDED JOINTS Abstract Only
V. F. Kozhevnikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 81 Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow, USSR), no. 11, Nov. 1986 p 38-40 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21340# Joint Publications Research Service, Arlington, Va.
METHOD FOR FINDING PRINCIPAL MODES OF NONLINEAR VIBRATION SYSTEMS AND THEIR STABILITIES Abstract Only
Liansheng Liu, Kelei Huang, and Quanzhong Huo *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 2 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 505-512 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21341# Joint Publications Research Service, Arlington, Va.
FURTHER STUDY OF RELATION OF VON KARMAN EQUATION FOR ELASTIC LARGE DEFLECTION PROBLEM AND SCHRODINGER EQUATION FOR QUANTUM EIGENVALUES PROBLEM Abstract Only
Huichuan Shen *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 3 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqin, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 539-546 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

42 GEOSCIENCES (GENERAL)

N88-21536 Centre National d'Etudes Spatiales, Toulouse (France).
CLIMATOLOGY AND SPACE OBSERVATIONS
Sep. 1987 916 p Partly in ENGLISH and FRENCH Proceedings of the International Summer School of Space Physics Course, Paris, France, 1986
(ISBN-2-85-428179-9; ISSN-0766-1002; ETN-88-92022)
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Atmospheric processes and climatic models, radiative processes, soil processes, ocean processes, and sea ice and continental ice were discussed. For individual titles, see N88-21537 through N88-21573.

N88-21537 Centre National de la Recherche Scientifique, Paris (France). Inst. National des Sciences de l'Univers.
INTRODUCTION TO THE DYNAMICS OF THE OCEAN AND THE ATMOSPHERE [INTRODUCTION A LA DYNAMIQUE DE L'OCEAN ET DE L'ATMOSPHERE] **c46**
Andre Berroir *In* CNES, Climatology and Space Observations Sep. 1987 p 19-31 In FRENCH (For primary document see N88-21536 14-42)
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The general characteristics of the atmospheric and oceanic circulation are described including stratification, geostrophy, zone distribution, Walker circulation, ocean stratification, ocean geostrophic circulation, surface circulation, Eckman pumping, and deep circulation. The energetic balance of the atmosphere-ocean system is discussed, and the Earth radiation budget is described. ESA

N88-21538 Direction de la Meteorologie Nationale, Paris (France).
THE WORLD CLIMATE RESEARCH PROGRAM [LE PROGRAMME MONDIAL DE RECHERCHE SUR LE CLIMAT] **c47**
P. Waldteufel *In* CNES, Climatology and Space Observations Sep. 1987 p 33-53 In FRENCH (For primary document see N88-21536 14-42)
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The Wold Climate Research Program is implemented in three streams and six subprograms which are described. These include the prevision of the atmospheric climate, the coupled boundary limits of the ocean and the atmosphere, the tropical ocean and global atmosphere, the world ocean circulation experiment, and the cryosphere. ESA

N88-21539 Centre National d'Etudes Spatiales, Paris (France).
SPACE PROJECTS FOR THE 90'S RELEVANT TO CLIMATOLOGY [LES PROJETS SPATIAUX DES ANNEES 1990 INTERESSANT LA CLIMATOLOGIE] **c84**
Jean-Louis Fellous *In its* Climatology and Space Observations Sep. 1987 p 55-70 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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Major space programs and related experiments relevant for climatic studies are reviewed with special emphasis on programs involving participation by French teams. Future programs presently under elaboration in the context of Polar Platform concepts being developed by the U.S. and Europe are also mentioned. ESA

N88-21540 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE ATMOSPHERE AS A COMPONENT OF THE CLIMATE SYSTEM: STRUCTURE AND VARIABILITY **c47**
Robert Sadourny *In* CNES, Climatology and Space Observations Sep. 1987 p 73-100 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

The main features of the general circulation of the atmosphere, its energetics, and its variability are described. It is shown that in the tropics the energetics of the general circulation is related to the divergent Hadley-Walker circulation, and it is only partially predictable. In middle latitudes the role of the internal variability modes is enhanced which makes it practically unpredictable. The modes of fast variability are the baroclinic transients which are of little interest to climatology, while the slow variability modes are of direct climatic interest since their organization in space gives rise to teleconnection patterns. ESA

N88-21541 European Centre for Medium-Range Weather Forecasts, Reading (England).
ADIABETIC FORMATION OF LARGE-SCALE MODELS OF THE ATMOSPHERE **c47**
D. M. Burridge *In* CNES, Climatology and Space Observations Sep. 1987 p 101-145 (For primary document see N88-21536 14-42)
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The adiabatic formulation for the primitive models used for operational weather forecasting and climate simulation is described. Forms for the basic equations are introduced and the two main approaches for the horizontal representation, namely the finite difference and the spectral techniques are discussed. The design and implementation of schemes for vertical discretization are examined and resolution experiments are commented. ESA

N88-21542 European Centre for Medium-Range Weather Forecasts, Reading (England).
REPRESENTATION OF PHYSICAL PROCESSES IN GLOBAL ATMOSPHERIC MODELS **c47**
G. Sommeria *In* CNES, Climatology and Space Observations Sep. 1987 p 147-179 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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General information is given on the relative importance of various physical processes on atmospheric budgets. Thermodynamical processes, i.e., turbulent and convective exchanges of heat and water are emphasized. Examples illustrate the role of physical parameterization schemes in global models. ESA

N88-21543 Direction de la Meteorologie Nationale, Paris (France).
PARAMETERIZATION OF RADIATION IN A GENERAL CIRCULATION MODEL **c47**
J. F. Geleyn *In* CNES, Climatology and Space Observations Sep. 1987 p 181-189 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The design methods most appropriate to take into account the special features of global circulation models are reviewed. Formulation of objectives, listing of available resources, input data

treatment, choice of space-time resolution, and output configuration are considered. Implementation and diagnosis of this type of model are discussed. ESA

N88-21544 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
ASSIMILATION OF METEOROLOGICAL OBSERVATIONS c47
Olivier Talagrand *In* CNES, Climatology and Space Observations Sep. 1987 p 191-206 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The optimal analysis operational technique, used to define the initial conditions of a numerical meteorological forecast from observations distributed in space and time is described. Optimal analysis is an iterative method of corrections of the state of the model at successive times, through statistical linear regression. Optimal analysis is described as a degraded form of Kalman-Bucy filtering. Variational approaches to the assimilation problem are also discussed. ESA

N88-21545 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
CARBON DIOXIDE AND CLIMATE c47
Robert S. Kandel *In* CNES, Climatology and Space Observations Sep. 1987 p 207-217 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The factors governing the increase of atmospheric concentration of CO2 (from 318 ppm in 1957 to more than 340 today) are reviewed and the effects on the biosphere and on climate of a continuation of this trend to doubled CO2 levels are examined. It is shown that although the physics of the climate effect can be illustrated with a simple model, the complexity of climate feedbacks can only be represented with comprehensive modeling of the climate system. Early detection of the climate signals corresponding to the present day increased CO2 level is problematic. Possible consequences for humanity of the climate change predicted by most models for CO2 doubling are discussed. ESA

N88-21546 Centre National de Recherches Meteorologiques, Toulouse (France).
SEA SURFACE TEMPERATURES OF WINTER 1982-83 AND THEIR EFFECT ON ATMOSPHERIC CIRCULATION c47
J. F. Royer *In* CNES, Climatology and Space Observations Sep. 1987 p 219-227 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The strong positive anomaly of the ocean surface temperature which persisted in the eastern part of the Equatorial Pacific in winter 1982 is discussed. A general circulation model of the atmosphere is used to simulate the modifications of atmospheric circulation caused by these abnormal sea surface temperatures. The comparison of the simulation with the anomalies observed during this period is used to identify and to describe the characteristic response of the atmosphere to the presence of a warm anomaly in the equatorial ocean. ESA

N88-21547 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
LIDAR ACTIVE REMOTE SENSING. APPLICATIONS TO THE ATMOSPHERE [TELEDETECTION ACTIVE PAR LIDAR. APPLICATIONS ATMOSPHERIQUES] c43
Pierre H. Flamant *In* CNES, Climatology and Space Observations Sep. 1987 p 229-255 In FRENCH (For primary document see N88-21536 14-42)
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Lidar operation is explained and applications to the study of the atmosphere are described. The laser sources mentioned include CO2 at 9 to 11 microns, Nd-YAG at 1.064 and 0.53 microns, and dye lasers in the near infrared. Lidar atmospheric methods include Rayleigh elastic diffusion, nonelastic Raman diffusion, differential laser absorption, atomic resonance, and Doppler effect. It is shown that the described applications are largely adopted by most atmospheric programs, including satellite observation programs. ESA

N88-21548 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE EARTH RADIATION BUDGET AND ITS SPATIAL AND TEMPORAL VARIATIONS c46
Robert S. Kandel *In* CNES, Climatology and Space Observations Sep. 1987 p 259-310 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The components of the Earth radiation budget are defined and their role as a climate mechanism is examined. The principal results of satellite experiments on the geographical distribution of Earth radiation budget components, their annual cycle, and their variability are reviewed. Procedures to obtain unbiased estimates of Earth radiation budget components from satellite observations are discussed. The solutions adopted in NASA's Earth Radiation Budget Experiment are described. ESA

N88-21549 Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Optique Atmospherique.
THE ROLE OF RADIATION TRANSFER IN CLIMATE MODIFICATION [LE ROLE DU TRANSFERT RADIATIF DANS LA MODELISATION DU CLIMAT] c47
Y. Fouquart *In its* Climatology and Space Observations Sep. 1987 p 311-369 In FRENCH (For primary document see N88-21536 14-42)
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The problems found to compute radiation transfer in modeling planetary climate are discussed and short and long wavelength parameterizations are described. The concepts necessary to the understanding of the radiation coding principles used to simulate climate are explained. It is shown that the most impressive development is in the processing of cloud radiation. The parameterization of liquid water content in clouds is estimated to be one of the main problems. ESA

N88-21550 California Univ., San Diego, La Jolla. California Space Inst.
NET RADIATIVE FLUX AT THE EARTH SURFACE: ESTIMATION FROM SATELLITE OBSERVATIONS c46
Catherine Gautier *In* CNES, Climatology and Space Observations Sep. 1987 p 371-382 (For primary document see N88-21536 14-42)
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Terms composing the net surface radiative flux are introduced, and procedures which lead to the determination of these terms from satellite spectral radiance for climate applications are presented. It is shown that most of the tools necessary to the task exist already, including accurate radiative transfer models, calibrated satellite radiance measurements, and inversion procedures. ESA

N88-21551 California Univ., San Diego, La Jolla. California Space Inst.
SATELLITE ESTIMATIONS OF THE SOLAR RADIATION FLUX AT THE SURFACE c46
Catherine Gautier *In* CNES, Climatology and Space Observations Sep. 1987 p 383-405 (For primary document see N88-21536 14-42)
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The daily cumulative insolation in a large variety of cloud cases can be estimated within 9 percent of the mean insolation. Satellite capabilities almost equal those of pyranometers at vastly improved

spatial resolutions. A pronounced correlation is found between insolation and both zenith angle and cloudiness. Methods of this type will soon be implemented at low cost with small personal computers that could be used as dedicated processors. ESA

N88-21552 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
SATELLITE RETRIEVAL OF CLOUD COVER PARAMETERS AND THE INTERNATIONAL SATELLITE CLOUD CLIMATOLOGY PROGRAM (ISCCP) c43
Michel Desbois *In* CNES, Climatology and Space Observations Sep. 1987 p 407-419 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The quantitative determination of cloud characteristic parameters in the frame of the ISCCP program is discussed. The ISCPP aims to build a global climatology for 5 yr. The principles of these methods are described, and problems are outlined, including the problem of in situ validation. Examples of the use of the ISCCP data set for the description of climatic variations of the cloud cover are given. ESA

N88-21553 Institut National de la Recherche Agronomique, Paris (France).
MODELING SURFACE EXCHANGES: THE SOIL-VEGETATION-ATMOSPHERE CONTINUUM [MODELISATION DES ECHANGES DE SURFACE: CONTINUUM SOL-PLANTE-ATMOSPHERE] c46
A. D. Perrier *In* CNES, Climatology and Space Observations Sep. 1987 p 423-456 In FRENCH (For primary document see N88-21536 14-42)
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The basic processes regulating the exchange of climatic factors are described in order to calculate climatic balances. The application of notions such as flow resistance and surface potential is suggested. It is shown that the soil-vegetation-atmosphere complex may be treated in space diversity as a single entity. The adopted method is based on the linearization of the temperature gradients. The applications discussed include a model of soil surface, a vegetation model, and equilibrium temperature determination. ESA

N88-21554 Meteorological Office, Bracknell (England).
AN INTRODUCTION TO THE PARAMETERIZATION OF LAND-SURFACE PROCESSES c46
D. J. Carson *In* CNES, Climatology and Space Observations Sep. 1987 p 457-502 (For primary document see N88-21536 14-42)
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For nonvegetated land surfaces, the general boundary conditions for momentum transfer and the balance equations for energy and mass (moisture) transfer at a bare-soil surface are identified. The physical character and the parameterization of the varied flux-terms at the surface are considered, including surface radiative properties and fluxes, surface turbulent exchanges, soil heat conduction, land surface temperature, and surface hydrology and the soil water budget. ESA

N88-21555 Centre National de Recherches Meteorologiques, Toulouse (France).
CONTINENTAL SURFACE PROCESSES AND WATER CYCLE [PROCESSUS DE SURFACE CONTINENTALE ET CYCLE DE L'EAU] c46
Jean-Claude Andre *In* CNES, Climatology and Space Observations Sep. 1987 p 503-514 In FRENCH (For primary document see N88-21536 14-42)
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The exchanges of mass and energy between the continental surface and the atmosphere are described by the energy budget available at the interface. The climatic importance of the continental surface processes is emphasized, and the main contributions to this problem are reviewed. The analysis includes the progress of desertification, showing that the existence of multiple positive and negative feedback loops makes necessary a large dose of accuracy in measuring continental surface processes and water cycles. ESA

N88-21556 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
SENSITIVITY OF GENERAL CIRCULATION MODELS TO SURFACE PROCESSES [SENSIBILITE DES MODELES DE CIRCULATION GENERALE AUX PROCESSUS DE SURFACE] c46
K. Laval *In* CNES, Climatology and Space Observations Sep. 1987 p 515-530 In FRENCH (For primary document see N88-21536 14-42)
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Sensitivity studies related to surface processes are described, including numerical simulations to understand the influence of surface albedo variation on desertification, the effects of changes in evaporation over continents on continental climates, and in particular on precipitation and winds, and the influence of a soil moisture anomaly on long term water cycle modifications affecting these regions. It is concluded that general circulation models show the consequences of variations in the exchanges between soil and atmosphere on the climate. Suggestions for refining this type of analysis are made. ESA

N88-21557 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT FROM SATELLITES OF LAND SURFACE PARAMETERS AND FLUXES IN THE THERMAL INFRARED BANDS: PROBLEMS AND METHODS c46
F. Becker *In* CNES, Climatology and Space Observations Sep. 1987 p 531-576 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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The main problems arising in the elaboration of accurate and reliable algorithms for extracting land surface parameters and flux from their measured radiances are discussed. Methods of solution in the thermal infrared spectral domain are described. Particular interest is given to the inversion of thermal models and to the problems resulting from the heterogeneity of the observed surfaces. ESA

N88-21558 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE INTERNATIONAL SATELLITE LAND-SURFACE CLIMATOLOGY PROJECT (ISLSCP) c47
S. I. Rasool *In* CNES, Climatology and Space Observations Sep. 1987 p 577-581 (For primary document see N88-21536 14-42)
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The initiatives undertaken by NASA and others to promote the activities of ISLSCP in the U.S., Europe, or Africa are described. The main objective is to develop consistent methodologies to derive quantitative values of changes in land surface characteristics on a continental scale, over several years. The project status is described as being at mid-point. ESA

N88-21559 Ecole Nationale Superieure des Mines, Paris (France). Centre d'Information Geologique.
HYDROLOGICAL MODELS c43
G. Girard *In* CNES, Climatology and Space Observations Sep. 1987 p 583-598 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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An integrated model for surface water and groundwater flow in a drainage area based on a breakdown of the water cycle in spatial and temporal terms is described. It is shown how the model was used to estimate the evapotranspiration flux in the framework of project Hapex-Mobilhy in France. ESA

N88-21560 Centre National de Recherches Meteorologiques, Toulouse (France).
THE HAPEX-MOBILHY PROGRAM [LE PROGRAMME HAPEX-MOBILHY] **c47**
Jean-Claude Andre *In* CNES, Climatology and Space Observations Sep. 1987 p 599-608 In FRENCH (For primary document see N88-21536 14-42)
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The program is a hydrological atmospheric pilot experiment and it involves modeling the water balance. It studies the water balance and evaporation flux in a continental surface of 10,000 sq km, a size comparable to a cell of the general circulation models. The objective is to produce a set of hydrological and atmospheric data necessary to improve the existing knowledge of water cycles and its influence on climate. A data bank is created to gather all kinds of experimental information related to the program. ESA

N88-21561 Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
MEASUREMENT OF THE WATER CONTENT OF SOIL FROM SPACE AND APPLICATION TO THE REGIONAL WATER BALANCE [MESURES DU CONTENU EN EAU DES SOLS DEPUIS L'ESPACE ET APPLICATION AU BILAN HYDRIQUE REGIONAL] **c43**
Daniel Vidal-Madjar *In* CNES, Climatology and Space Observations Sep. 1987 p 609-628 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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Work done to measure the regional soil water budget is described. The parameters which are measurable are identified and it is possible to define strategies for applications to climatology. It is shown that measurement from space of soil moisture is possible either by infrared thermal radiation measurement or by radar measurements. Advantages of each method are discussed. ESA

N88-21562 Florida State Univ., Tallahassee.
LARGE-SCALE OCEAN DYNAMICS **c48**
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 631-642 (For primary document see N88-21536 14-42)
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The mathematical equations that govern oceanic circulation on the global scale are established, and their physical implications are discussed. Solutions to the set of equations are not developed. Scaling, use of density as the vertical coordinate, and Lagrangian considerations are used. ESA

N88-21563 Florida State Univ., Tallahassee.
THE MAIN OCEAN THERMOCLINE **c48**
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 643-654 (For primary document see N88-21536 14-42)
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The so-called ocean thermocline problem is discussed. The problem is centered on explaining why the pronounced vertical stratification in the ocean below the maximum penetration of winter convective mixing is permanently maintained against vertical diffusion. Observations, key ideas, and theories are reviewed. Physical ideas which provide methods of attack are outlined. A general conclusion is that the main thermocline cannot be dissociated from the horizontal circulation pattern. ESA

N88-21564 Florida State Univ., Tallahassee.
WIND AND BUOYANCY DRIVEN OCEAN CIRCULATION **c48**
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 655-663 (For primary document see N88-21536 14-42)
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Large scale horizontal ocean circulation is discussed. The ventilated thermocline model provides a solution for a restricted region of the circulation. It is shown how an inertial western bounded current (such as the Gulf Stream) and an intense recirculation zone (such as the Sargossa Sea), where density changes are crucial, complete the circulation pattern at mid latitudes. A minimum mathematical formulation is included while emphasis is put on physical processes such as evolution of mass and angular moment along a particle's trajectory. ESA

N88-21565 Centre National de la Recherche Scientifique, Paris (France).
EQUATORIAL DYNAMICS AND OCEAN-ATMOSPHERE COUPLING **c46**
Pascale Delecluse *In* CNES, Climatology and Space Observations Sep. 1987 p 665-700 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

Equatorial ocean circulation is studied developing the equations describing the vertical and horizontal modes of the ocean currents. The particular case of El Nino current is analyzed. The analysis includes the response of the atmosphere and ocean-atmosphere coupling. It is shown that aperiodicity is determined by the natural variability of the system and the positive feedback of the system which is related to the seasonal deplacement of the thermocline. An additional source of nonlinearity is constituted by the atmospheric response. ESA

N88-21566 Paris VI Univ. (France).
OCEAN EDDIES [TOURBILLONS OCEANIQUES] **c48**
Christine Provost *In* CNES, Climatology and Space Observations Sep. 1987 p 701-762 In FRENCH (For primary document see N88-21536 14-42)
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Oceanic mesoscale eddies are discussed and a historical review of observations and theories is presented. It is argued that spatial observations are an ideal means for observing oceanic structures with spatial scales ranging from 10 to 200 km and with life time varying from a few days to several months. The role of eddies in climate and in particular in heat transport is examined, reviewing the results of local oceanic experiments and of numerical models. It is concluded that where the barocline instability is important the heat transport due to eddies may be non negligible. ESA

N88-21567 Centre National d'Etudes Spatiales, Toulouse (France). Groupe de Recherches de Geodesie Spatiale.
STUDY OF THE DYNAMIC TOPOGRAPHY OF OCEANS BY MEANS OF SATELLITE ALTIMETRY [ETUDE DE LA TOPOGRAPHIE DYNAMIQUE DES OCEANS PAR ALTIMETRIE SATELLITAIRE] **c48**
J. F. Minster *In its* Climatology and Space Observations Sep. 1987 p 763-813 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

Measuring problems and the correction of altimetric data are reviewed. The analysis refers to the results obtained with Seasat and GEOS3. The different methods of signal processing to extract the variability due to the mesoscale dynamic topography are described. Observations at large wavelength including tidal waves are discussed. It is concluded that the necessary accuracy to assess the ocean climatic role is attainable if all aspects of measurement are optimized. ESA

N88-21568 Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
BASIC NETWORKS OF TOGA: DETERMINATION OF THERMAL PROFILES BY XBT AND OF SEA LEVEL BY TIDE GAGE c48
J. R. Donguy *In* CNES, Climatology and Space Observations Sep. 1987 p 815-819 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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French participation in TOGA is reviewed. It includes the extension of the Pacific XBT network to the Atlantic and Indian oceans. The good monitoring of thermal structure anomalies which was obtained with El Nino in 1982 to 1983 guided network extension. The comparison of the data from XBT network with the data from the tide-gage network reveals a good correlation in the equatorial area between the thermocline depth and the sea level. ESA

N88-21569 Scott Polar Research Inst., Cambridge (England).
LARGE ICE MASSES: CHARACTERISTICS, BEHAVIOUR AND RELATION TO CLIMATE c48
David J. Drewry *In* CNES, Climatology and Space Observations Sep. 1987 p 823-834 (For primary document see N88-21536 14-42)
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The configuration and flow of ice sheets such as those in Greenland and Antarctica are described. In steady state the ice sheet would maintain its shape by changing the dischage of ice to compensate for variations in snow input. The temperature regime determines ice creep rates and sliding. The competition between atmospheric chilling and geothermal warming is the principal determinant of vertical temperature profiles. Ice flowing outward becomes channeled into ice streams and outlet glaciers which exhibit high flow rates. ESA

N88-21570 Scott Polar Research Inst., Cambridge (England).
THE ROLE OF REMOTE SENSING IN THE STUDY OF POLAR ICE SHEETS c43
David J. Drewry *In* CNES, Climatology and Space Observations Sep. 1987 p 835-847 (For primary document see N88-21536 14-42)
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Remote sensing methods including radar and laser altimetry to observe the configuration of ice sheets; microwave radiometry to measure short term accumulation and ablation patterns; microwave and infrared radiometry from the surface temperature; and imaging techniques to measure a variety of parameters by using specific techniques are reviewed. The measurement of ice thickness, however, is a major problem, and airborne methods are indicated for the time being. ESA

N88-21571 Laboratoire d'Oceanographie Dynamique et de Climatologie, Paris (France).
ELEMENTS OF SEA ICE DYNAMICS AND THERMODYNAMICS c48
J. C. Gascard *In* CNES, Climatology and Space Observations Sep. 1987 p 849-884 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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A classical thermodynamical model is described and compared with observational results related to Arctic conditions. Examples of sea ice dynamics and sea ice thickness distribution are described. Remote sensing is discussed and applications from the Seasat SAR and AVHRR/TQVS on NOAA are presented. ESA

N88-21572 Max-Planck-Inst. fuer Meteorologie, Hamburg (West Germany).
SEA ICE OBSERVATIONS AND MODELS c48
P. Lemke *In* CNES, Climatology and Space Observations Sep. 1987 p 885-895 (For primary document see N88-21536 14-42)
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The natural variability of sea ice is described and an attempt is made to describe sea ice fluctuations with simple thermodynamics. More advanced dynamic-thermodynamic models are also discussed. Sea ice anomalies are expected to appreciably affect the structure of the atmosphere and ocean circulations. In view of the long relaxation time of these anomalies, they are of considerable interest for the problem of long term weather prediction and climatic change. ESA

N88-21573 Laboratoire d'Oceanographie Dynamique et de Climatologie, Paris (France).
THE GREENLAND SEA PROJECT: THE ARCTEMIZ PROJECT c48
J. C. Gascard *In* CNES, Climatology and Space Observations Sep. 1987 p 897-916 (For primary document see N88-21536 14-42)
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The objectives of the program are to understand the sea-ice seasonal and interannual cycle of the transpolar sea-ice drift in the Nansen basin. Observations are programmed and a coupled ice-sea model is being developed. The observations include ice motions and deformations, surface winds and subsurface currents, sea-ice growth and decay, high quality concentration, and thickness distribution. ESA

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-21574# South Carolina Univ., Columbia. Dept. of Geography.
VEGETATION MAPPING USING HIGH RESOLUTION MSS (MULTISPECTRAL SCANNER) DATA: CANOPY REFLECTANCE AND SHADOW PROBLEMS ENCOUNTERED AND POSSIBLE SOLUTIONS
J. R. Jensen, M. E. Hodgson, J. Pinder, B. S. Collins, and H. E. Mackey, Jr. 1988 30 p Presented at the ASPRS Annual Meeting, St. Louis, Mo., 15 Mar. 1988 Prepared in cooperation with Colorado Univ., Boulder, Savannah River Ecology Lab., Aiken, S.C. and Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
(Contracts DE-AC09-76SR-00819; DE-AC09-76SR-00001; DE-AC08-83NV-10282)
(DE88-004273; DP-MS-87-111; CONF-880339-1) Avail: NTIS HC A03/MF A01

High resolution Multispectral Scanner (MSS) data were acquired for an old field, successional habitat in South Carolina. The instrument used was a Daedalus Model DS-1268 having 1.5 x 1.5 m spatial resolution and 11 spectral bands. The goal was to map the vegetation of the study area and compute standing biomass. Upon examination of the MSS data, it became apparent that additional information would be required to accurately discriminate between the vegetation types because of (1) nonuniformity of canopy reflectance from individual trees due to sun angle and azimuth, and (2) shadows cast by trees. This paper describes the nature of the canopy reflectance problem, methods of removing the effects of shadows in high resolution MSS data, and the computation of biomass for the study area. DOE

N88-21575# Technische Hogeschool, Delft (Netherlands). Orbital Mechanics Section.
FROM SATELLITE ALTIMETRY TO OCEAN TOPOGRAPHY, A SURVEY OF DATA PROCESSING TECHNIQUES
K. F. Wakker, R. C. A. Zandbergen, G. H. M. vanGeldorp, and B.

A. C. Ambrosius 1987 41 p Presented at the EARSeL Symposium on Remote Sensing Needs in the 1990's, Oceanography/Sea Ice Workshop, Noordwijkerhout, Netherlands, 4-8 May 1987 Revised Sponsored by ESA-ESOC, Darmstadt, Fed. Republic of Germany; The Netherlands Space Research Organisation, Utrecht, Netherlands; and Begeleidirgscommissie Remote Sensing, Delft, Netherlands
(ETN-88-91841) Avail: NTIS HC A03/MF A01

Satellite altimetry missions and altimeter data processing are reviewed. Orbit computation accuracy is addressed. Examples of geophysical products obtained from Seasat altimeter measurements are discussed. ESA

N88-21576# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.
THE MONTE GENEROSO-ZIMMERWALD (SWITZERLAND) BASELINE FROM SATELLITE LASER RANGING DATA USING VARIOUS ANALYSIS TECHNIQUES
E. Papazissi (National Technical Univ., Athens, Greece), R. Noomen, and B. H. W. vanGelder Oct. 1987 24 p
(LR-533; ETN-88-91843) Copyright Avail: NTIS HC A03/MF A01

Accuracy of laser ranging data from LAGEOS, used to calculate a baseline in the Swiss Alps for plate tectonic studies, was determined. All solutions of the baseline computed with completely different analysis techniques, are consistent to within 5 cm. Results based upon long data arcs are generally larger than those obtained with short data arcs. Investigation of possible effects due to modeling errors is needed. The contribution of ranging data of other laser stations to the computed baseline appears to be insignificant, if the data are evaluated with 1-, 2- or 3-revolution data arcs with simultaneous tracking of both stations. The length of the baseline Monte Generoso - Zimmerwald (MGZ) amounts to 159391.43 + or - 0.01 m. The values for the baseline MGZ, computed from satellite laser range measurements and GPS measurements, are consistent to within a few centimeters. The terrestrial network in the southern part of Switzerland is affected by a scaling error of approximately 7 ppm. ESA

N88-21577*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SPRING 1985 HIGH PRECISION BASELINE TEST OF THE JPL GPS-BASED GEODETIC SYSTEM Final Report
John M. Davidson, Catherine L. Thornton, Scott A. Stephens, Geoffrey Blewitt, Stephen M. Lichten, Ojars J. Sovers, Peter M. Kroger, Lisa L. Skrumeda, James S. Border, and Ruth E. Neilan et al. 15 Nov. 1987 79 p
(Contract NAS7-918)
(NASA-CR-182686; JPL-Pub-87-35; NAS 1.26:182686) Avail: NTIS HC A05/MF A01 CSCL 08E

The Spring 1985 High Precision Baseline Test (HPBT) was conducted. The HPBT was designed to meet a number of objectives. Foremost among these was the demonstration of a level of accuracy of 1 to 2:10 to the 7th power, or better, for baselines ranging in length up to several hundred kilometers. These objectives were all met with a high degree of success, with respect to the demonstration of system accuracy in particular. The results from six baselines ranging in length from 70 to 729 km were examined for repeatability and, in the case of three baselines, were compared to results from colocated VLBI systems. Repeatability was found to be 5:10 to the 8th power (RMS) for the north baseline coordinate, independent of baseline length, while for the east coordinate RMS repeatability was found to be larger than this by factors of 2 to 4. The GPS-based results were found to be in agreement with those from colocated VLBI measurements, when corrected for the physical separations of the VLBI and CPG antennas, at the level of 1 to 2:10 to the 7th power in all coordinates, independent of baseline length. The results for baseline repeatability are consistent with the current GPA error budget, but the GPS-VLBI intercomparisons disagree at a somewhat larger level than expected. It is hypothesized that these differences may result from errors in the local survey measurements used to correct for the separations of the GPS and VLBI antenna reference centers. Author

N88-21578# Stuttgart Univ. (West Germany). Inst. fuer Photogrammetrie.
CLASSIFICATION OF SMALL IMAGE AREAS BY DIGITAL CORRELATION FOR THE CONNECTION OF DIFFERENT IMAGES IN PHOTOGRAMMETRY AND LONG-RANGE RECONNAISSANCE Final Report [ZUORDNUNG KLEINER BILDFLAECHEN DURCH DIGITALE KORRELATION ZUR VERKNUEPFUNG VERSCHIEDENER ODER VERSCHIEDENARTIGER BILDER IM ANWENDUNGSBEREICH PHOTOGRAMMETRIE UND FERNERKUNDUNG]
F. Ackermann and A. Pertl Jan. 1983 53 p In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn (Federal Republic of Germany)
(ETN-88-91506) Avail: NTIS HC A04/MF A01

A correlation algorithm was developed as a method for digital image processing. The algorithm transforms the image area elements to be correlated, minimizing gray value differences by the least squares method. The transformation parameters are directly determined by the adjustment. The flexibility of the algorithm allows the recognition and compensation of distortions. The algorithm provides a criterion for the quality of the correlation and for the remaining disturbances. The empirical results are confirmed by theoretical studies. For the transmission of points in aerial pictures a precision of 1 micron is obtained. The accuracy of the correlation is affected by long-wavelength perturbations. The results are also affected by perturbations in the data sets of the digitized images. ESA

N88-21579# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Fernerkundung.
LAND-USE CLASSIFICATION IN A REGION NORTH-WEST OF WUERZBURG (FEDERAL REPUBLIC OF GERMANY) USING DIGITAL, MULTISPECTRAL LANDSAT 5 THEMATIC MAPPER DATA Thesis - Wuerzburg Univ.
Stefan W. Dech Jul. 1987 188 p In GERMAN; ENGLISH summary Original contains color illustrations
(DFVLR-FB-87-37; ISSN-0171-1342; ETN-88-91921) Avail: NTIS HC A09/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 52 Deutsche marks

Using a LANDSAT TM scene the land-use of a predominantly rural area was recorded by digital image processing techniques. In order to distinguish a maximum of land cover types, possibilities of interactive separation of different classes, with almost similar spectral reflection, are shown. The results of the supervised maximum likelihood classification as well as a color composite are superimposed with selected topographical information. Methods of visual interpretation are presented. ESA

N88-21580# Universite Catholique de Louvain (Belgium). Lab. de Teledetection.
INVESTIGATION OF EUROPEAN REMOTE SENSING USER NEEDS IN ACCESSING MOS-1 PAYLOAD Final Report
J. Wilmet and M. Egleme Paris, France ESA Jan. 1987 153 p
(Contract ESRIN-6630/86-HGE-1)
(ESA-CR(P)-2535; ETN-88-91969) Avail: NTIS HC A08/MF A01

Marine Observation Satellite (MOS) 1 impact on future European remote sensing activities is examined in terms of the overall availability of Earth observation satellites between 1987 and 1991 and the measuring capabilities of the available sensors. The contribution of MOS-1 to land, ocean, and atmospheric applications is qualitatively analyzed by defining the utility of MOS and other available sensors to various application objectives. An entropy-based model allows for a quantitative evaluation of the sensors' relative information content for various applications. The MOS-1 expected performances for various applications are confronted with user requirements for these applications. User needs and groups of potential applications are identified through

a survey of 79 national or international research institutions and 5 private institutions in 19 European countries. Data format requirements and recommendations are gathered. The interest of the user community in participating in a European MOS Verification Program is assessed to assist in the preparation of the Announcement of Opportunity for the Verification Program. ESA

N88-21581# Royal Aircraft Establishment, Farnborough (England).
GENERALISED THRESHOLD SELECTION FOR EDGE DETECTION
J. F. Haddon May 1987 21 p
(RAE-TR-87035; RAE-AW-24; BR103984; ETN-88-91890)
Copyright Avail: NTIS HC A03/MF A01

A generalized technique for selecting thresholds of edge strength maps from theoretical considerations of the noise statistics in images is derived. A technique for estimating the mean and variance of the noise of an image using a pair of images is described. The threshold selection technique can be applied to any single digital edge operator and was extended for use with combinations of edge operators. Two examples of thresholded edge maps using the techniques are shown. ESA

N88-21582*# California Univ., Santa Barbara. Center for Remote Sensing and Environmental Optics.
RESEARCH RELATIVE TO ANGULAR DISTRIBUTION OF SNOW REFLECTANCE/SNOW COVER CHARACTERIZATION AND MICROWAVE EMISSION Final Report, 1 Jul. 1983 - 30 Sep. 1987
Jeff Dozier and Robert E. Davis 1987 93 p
(Grant NAG5-328)
(NASA-CR-182733; NAS 1.26:182733) Avail: NTIS HC A05/MF A01 CSCL 08L

Remote sensing has been applied in recent years to monitoring snow cover properties for applications in hydrologic and energy balance modeling. In addition, snow cover has been recently shown to exert a considerable local influence on weather variables. Of particular importance is the potential of sensors to provide data on the physical properties of snow with high spatial and temporal resolution. Visible and near-infrared measurements of upwelling radiance can be used to infer near-surface properties through the calculation of albedo. Microwave signals usually come from deeper within the snow pack and thus provide depth-integrated information, which can be measured through clouds and does not relay on solar illumination.Fundamental studies examining the influence of snow properties on signals from various parts of the electromagnetic spectrum continue in part because of the promise of new remote sensors with higher spectral and spatial accuracy. Information in the visible and near-infrared parts of the spectrum comprise nearly all available data with high spatial resolution. Current passive microwave sensors have poor spatial resolution and the data are problematic where the scenes consist of mixed landscape features, but they offer timely observations that are independent of cloud cover and solar illumination. Author

N88-21583*# Applied Science Analytics, Inc., Canoga Park, Calif.
ESTIMATION OF GEOPOTENTIAL FROM SATELLITE-TO-SATELLITE RANGE RATE DATA: NUMERICAL RESULTS Final Report, Aug. 1983 - Jan. 1987
Glenn E. Thobe and Sam C. Bose Mar. 1987 107 p
(Contract NAS5-27743)
(NASA-CR-180771; NAS 1.26:180771) Avail: NTIS HC A06/MF A01 CSCL 13B

A technique for high-resolution geopotential field estimation by recovering the harmonic coefficients from satellite-to-satellite range rate data is presented and tested against both a controlled analytical simulation of a one-day satellite mission (maximum degree and order 8) and then against a Cowell method simulation of a 32-day mission (maximum degree and order 180). Innovations include: (1) a new frequency-domain observation equation based on kinetic energy perturbations which avoids much of the complication of the usual Keplerian element perturbation approaches; (2) a new method for computing the normalized inclination functions which unlike previous methods is both efficient and numerically stable even for large harmonic degrees and orders; (3) the application of a mass storage FFT to the entire mission range rate history; (4) the exploitation of newly discovered symmetries in the block diagonal observation matrix which reduce each block to the product of (a) a real diagonal matrix factor, (b) a real trapezoidal factor with half the number of rows as before, and (c) a complex diagonal factor; (5) a block-by-block least-squares solution of the observation equation by means of a custom-designed Givens orthogonal rotation method which is both numerically stable and tailored to the trapezoidal matrix structure for fast execution. Author

N88-21584*# Arizona Univ., Tucson. Optical Sciences Center.
THE ABSOLUTE RADIOMETRIC CALIBRATION OF THE ADVANCED VERY HIGH RESOLUTION RADIOMETER Semiannual Status Report
P. N. Slater, P. M. Teillet, and Y. Ding Apr. 1988 17 p
(Grant NAG5-859)
(NASA-CR-182755; NAS 1.26:182755) Avail: NTIS HC A03/MF A01 CSCL 08B

The need for independent, redundant absolute radiometric calibration methods is discussed with reference to the Thematic Mapper. Uncertainty requirements for absolute calibration of between 0.5 and 4 percent are defined based on the accuracy of reflectance retrievals at an agricultural site. It is shown that even very approximate atmospheric corrections can reduce the error in reflectance retrieval to 0.02 over the reflectance range 0 to 0.4. Author

N88-21369# Joint Publications Research Service, Arlington, Va.
ANALYSIS, SUPPRESSION OF LAND CLUTTER CHARACTERISTICS REPORTED
Fengzhen Wang and Xinbo Zhang *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 30-39 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 67; 98-103 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21547 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
LIDAR ACTIVE REMOTE SENSING. APPLICATIONS TO THE ATMOSPHERE [TELEDETECTION ACTIVE PAR LIDAR. APPLICATIONS ATMOSPHERIQUES]
Pierre H. Flamant *In* CNES, Climatology and Space Observations Sep. 1987 p 229-255 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21552 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
SATELLITE RETRIEVAL OF CLOUD COVER PARAMETERS AND THE INTERNATIONAL SATELLITE CLOUD CLIMATOLOGY PROGRAM (ISCCP)
Michel Desbois *In* CNES, Climatology and Space Observations Sep. 1987 p 407-419 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21559 Ecole Nationale Superieure des Mines, Paris (France). Centre d'Information Geologique.
HYDROLOGICAL MODELS
G. Girard *In* CNES, Climatology and Space Observations Sep. 1987 p 583-598 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21581 Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
MEASUREMENT OF THE WATER CONTENT OF SOIL FROM SPACE AND APPLICATION TO THE REGIONAL WATER BALANCE [MESURES DU CONTENU EN EAU DES SOLS DEPUIS L'ESPACE ET APPLICATION AU BILAN HYDRIQUE REGIONAL]
Daniel Vidal-Madjar *In* CNES, Climatology and Space Observations Sep. 1987 p 609-628 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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N88-21570 Scott Polar Research Inst., Cambridge (England).
THE ROLE OF REMOTE SENSING IN THE STUDY OF POLAR ICE SHEETS
David J. Drewry *In* CNES, Climatology and Space Observations Sep. 1987 p 835-847 (For primary document see N88-21536 14-42)
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44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-21585*# Boeing Co., Seattle, Wash.
THERMOPHOTOVOLTAIC SPACE POWER SYSTEM, PHASE 3 Final Report
W. E. Horne and C. Lancaster 2 Feb. 1987 77 p
(Contract NAS8-33436)
(NASA-CR-179327; NAS 1.26:179327) Avail: NTIS HC A05/MF A01 CSCL 10B

Work performed on a research and development program to establish the feasibility of a solar thermophotovoltaic space power generation concept was summarized. The program was multiphased. The earlier work is summarized and the work on the current phase is detailed as it pertains to and extends the earlier work. Much of the experimental hardware and materials development was performed on the internal program. Experimental measurements and data evaluation were performed on the contracted effort. The objectives of the most recent phase were: to examine the thermal control design in order to optimize it for lightweight and low cost; to examine the concentrator optics in an attempt to relieve pointing accuracy requirements to + or - 2 degrees about the optical axis; and to use the results of the thermal and optical studies to synthesize a solar thermophotovoltaic (STPV) module design that is optimized for space application.
Author

N88-21586# SERA Solar Corp., Santa Clara, Calif.
POLYSILICON-CONTACTED p+ EMITTERS FOR SILICON SOLAR CELL APPLICATIONS
Lee A. Christel Jan. 1988 61 p
(Contract DE-AC04-76DP-00789)
(DE88-005106; SAND-87-7021) Avail: NTIS HC A04/MF A01

A polysilicon-contact technology was investigated as a method of reducing the minority carrier recombination that occurs in boron-doped p+ emitter structures in silicon. Two different polysilicon processes using low-pressure chemical-vapor deposition were used. Undoped polysilicon that was later doped by furnace predeposition was compared with in situ-doped polysilicon followed by diffusion. PNP transistors were used as the test structure. The emitter saturation current densities measured on devices with and without polysilicon were compared. The effect of a chemically grown oxide beneath the polysilicon was also investigated. Devices with polysilicon-contacted emitters performed marginally better than those with simple metal contacts. A barrier oxide between the polysilicon and single-crystal emitter was found to offer additional improvement. The magnitude of the emitter saturation current densities observed was not as low as that seen in n-type emitter structures.
DOE

N88-21587# Commission of the European Communities, Ispra (Italy).
ENERGY STORAGE AND TRANSPORT BY REVERSIBLE CHEMICAL REACTIONS
G. Beghi 1987 38 p In FRENCH; ENGLISH summary
(DE88-900370; EUR-10876) Avail: NTIS (US Sales Only)
HC A03/MF A01

Reversible thermochemical reactions are one of the possibilities to store and transport high temperature heat (800 K up to 1300 K). There are open cycles and closed cycles. Some reversible systems are described, as the SO2-SO3 system. A typical example of open cycle is the reaction for water decomposition. Results of a pilot plant to verify the decomposition of sulfuric acid are described; the technological feasibility of this method for hydrogen production is shown. The possibility to use other high temperature sources, as solar energy is discussed.
DOE

N88-21588# Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires.
NEW AIRFOIL SECTIONS FOR STRAIGHT BLADED TURBINE M.S. Thesis
B. Boumaza Jul. 1987 88 p In FRENCH; ENGLISH summary (TI88-701075; INIS-mf-11056) Avail: NTIS (US Sales Only) HC A05/MF A01

A theoretical investigation of aerodynamic performance for vertical axis Darrieus wind turbine with new airfoils sections is carried out. The blade section aerodynamics characteristics are determined from turbomachines cascade model. The model is also adapted to the vertical Darrieus turbine for the performance prediction of the machine. In order to choose appropriate value of zero-lift-drag coefficient in calculation, an analytical expression is introduced as function of chord-radius ratio and Reynolds numbers. New airfoils sections are proposed and analyzed for straight-bladed turbine.
DOE

N88-21589# Technische Hogeschool, Eindhoven (Netherlands). Vakgroep Transportfysica.
THE 25 m HORIZONTAL-AXIS TURBINE AS A TEST CASE FOR STANDARD DUTCH AERODYNAMIC CALCULATION METHODS FOR HIGH-SPEED ROTORS [DE 25 M HAT ALS TESTCASE VOOR DE IN NEDERLAND GANGBARE AERODYNAMISCHE REKENMODELLEN VOOR SNELLOPERS]
G. J. W. vanBussel (Technische Hogeschool, Delft, Netherlands) and G. A. M. vanKuik 1987 22 p In DUTCH
(R-762-D; IW-R507; ETN-88-91308) Avail: NTIS HC A03/MF A01

Operational methods for the calculation of the aerodynamic performances of horizontal-axis wind turbines (HAT) were tested on a reference rotor, namely a 25 m HAT. The different theoretical models are described. The rotor specifications of the reference case are given. The results of the different calculations are compared, and the predicted values are compared with measured data. A good prediction of the axial force and power is not possible with the present methods. In contrast with the expectations, the discrepancy between measurements and calculations, as well as among the different calculations, does not decrease with increasing pitch angle. The differences between measurements and calculations are not systematic.
ESA

N88-21590# BUG-Alutechnik G.m.b.H., Vogt (West Germany).
DEVELOPMENT OF A MANUFACTURING UNIT FOR SELECTIVE COATING OF SOLAR ABSORBERS MADE OUT OF ALUMINUM Final Report, Dec. 1984
Rudolf Stemmer Bonn, Fed. Republic of Germany BMFT Dec. 1986 70 p In GERMAN; ENGLISH summary Sponsored by

BMFT, Bonn, Fed. Republic of Germany
(BMFT-FB-T-86-204; ISSN-0340-7608; ETN-88-91937) Avail: NTIS HC A04/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 14.50 Deutsche marks + MWST

Based on a detailed description of the coating process, a manufacturing unit was planned to make possible the economic coating of solar absorbers by using the periphery of the anodizing plant without disturbing the running of the plant. All components were tested concerning technical function, reliability, and security. The coated samples were examined concerning their optical and technical characteristics. After test working, manufacturing instructions were supplied and the staff was trained. During test phase 2, problems occurred which must be solved in a succeeding project: the contamination of sodium and the negative influence of seal poisons. ESA

N88-21591# Stuttgart Univ. (West Germany). Inst. fuer Theorie der Elektrotechnik.
TECHNICAL APPLICATIONS OF SOLAR ENERGY. PROJECT: SELECTIVE COATINGS Final Report, Sep. 1985
Karlhanns Gindeke, Karl Honstetter, Michael Koehl, Guenther Lehner, and Michael Mast Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 62 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany
(BMFT-FB-T-86-213; ISSN-0340-7608; ETN-88-92097) Avail: NTIS HC A04/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany, 13 deutsche marks + MWST

Selective solar absorber coatings were studied. Methods for the determination of the spectral directional emittance, particularly with the use of an integrating sphere in the infrared, are compared. A procedure for the extraction of characteristic quantities describing the surface structure, as correlation length and mean distance between the structure elements, from scanning electron microscope images is explained. Production of cermet layers with PVD especially with a graded volume fraction of the metal is described. For Ni/MgF2 layers absorptance values from 0.95 to 0.97 at emittances from 0.5 to 0.10 are reached. Models for the theoretical description are discussed. The influence of production parameters on the optical properties of nickel oxide coatings deposited in an ac electroplating process is represented. A method for the estimation of the life time with accelerated tests at constant temperatures is investigated for copper oxide coatings. ESA

N88-21592# Ludwig-Maximilians-Universitaet, Munich (West Germany). Lehrstuhl fuer Experimentalphysik.
DIRECT CONVERSION OF SOLAR ENERGY TO THERMAL ENERGY Final Report, Jul. 1985
Rudolf Sizmann Bonn, Federal Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 135 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany
(BMFT-FB-T-86-220; ISSN-0340-7608; ETN-88-92098) Avail: NTIS HC A07/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany, 28 deutsche marks + MWST

Selective coatings (cermets) were produced by simultaneous evaporation of copper and silicon dioxide, and analyzed by computer assisted spectral photometers and ellipsometers; hemispherical emittance was measured. Steady state test procedures for covered and uncovered collectors were investigated. A method for evaluating the transient behavior of collectors was developed. The derived transfer functions describe their transient behavior. A stochastic approach was used for reducing the meteorological data volume. Data sets which are statistically equivalent to the original data can be synthesized. A simulation program for solar systems using analytical solutions of differential equations was developed. A large solar DHW system was optimized by a detailed modular simulation program. A microprocessor assisted data aquisition records the four characteristics of solar cells and solar cell systems in less than 10 msec. Measurements of a large photovoltaic installation (50 sqm) are reported. ESA

N88-21593*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF PRESSURE DISTRIBUTIONS ON MODEL AND FULL-SCALE NACA 64-621 AIRFOILS WITH AILERONS FOR WIND TURBINE APPLICATION Final Report
G. M. Gregorek, R. J. Kuniega (Ohio State Univ., Columbus.), and T. W. Nyland Apr. 1988 14 p
(Contract DE-AI01-76ET-20320)
(NASA-TM-100802; DOE/NASA/20320-75; E-3982; NAS 1.15:100802) Avail: NTIS HC A03/MF A01 CSCL 10B

The aerodynamic similarity between a small (4-inch chord) wind tunnel model and a full-scale wind turbine blade (24-foot tip section with a 36-inch chord) was evaluated by comparing selected pressure distributions around the geometrically similar cross sections. The airfoils were NACA 64-621 sections, including trailing-edge ailerons with a width equal to 38 percent of the airfoil chord. The model airfoil was tested in the OSU 6- by 12-inch High Reynolds Number Wind Tunnel; the full-scale blade section was tested in the NASA Langley Research Center 30- by 60-foot Subsonic Wind Tunnel. The model airfoil contained 61 pressure taps connected by embedded tubes to pressure transducers. A belt containing 29 pressure taps was fixed to the full-scale section at midspan to obtain surface pressure data. Lift coefficients were obtained by integrating pressures, and corrections were made for the 3-D effects of blade twist and downwash in the blade tip section. The results of the two different experimental methods correlated well for angles of attack from minus 4 to 36 degrees and aileron reflections from 0 to 90 degrees. Author

N88-21594# Sandia National Labs., Albuquerque, N. Mex.
THERMAL MODELING OF SOLAR CENTRAL RECEIVER CAVITIES
R. D. Skocypec and V. Romero 1988 12 p Presented at the 10th Annual American Society of Mechanical Engineers Solar Energy Conference, Denver, Colo., 10 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-004940; SAND-87-1569C; CONF-880457-3) Avail: NTIS HC A03/MF A01

Results are presented from a numerical model of the steady-state energy transfer in molten-salt-in-tube solar cavity receivers that includes convective energy transfer at a local (spatially resolved) level. Molten salt energy absorption and gray radiative transfer between all cavity surfaces are also included. This model is applied to the MSS/CTE cavity receiver. Results for this receiver indicate the global receiver thermal efficiency is invariant within a few percent to most parameters investigated, although front surface temperatures of the nonabsorbing walls vary considerably, and are particularly sensitive to the type of convective submodel used. Absorption efficiencies indicate the effects of the cavity enclosure environment. For all conditions investigated, tube inner wall temperatures remain under 855 K, ensuring that the salt remains chemically stable. Global (entire cavity) results for the receiver indicate thermal conditions in the receiver are temporally constant within an hour of solar noon, and solar panel temperatures are governed by the temperature of the flowing salt (the outlet temperature is maintained at 839 K by varying the salt mass flowrate). The dominant loss mechanism is radiative transfer. DOE

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-21595# Versar, Inc., Columbia, Md.
SPATIAL AND TEMPORAL DISTRIBUTION OF PRECIPITATION CHEMISTRY ACROSS MARYLAND IN 1984, VOLUME 1
C. Maxwell and S. Mahn Sep. 1987 112 p Sponsored by

Maryland Power Plant Research Program, Annapolis
(PB88-148929; PPRP/AD-87-10-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 13B

The results of a study, conducted from January to June 1987, in which existing deposition data for 1984 were colligated, examined for equality and consistency, and used to examine the temporal and spatial distributions of deposition and concentration for the chemical species collected in precipitation across Maryland and surrounding regions are presented. GRA

N88-21596# Versar, Inc., Columbia, Md.
SPATIAL AND TEMPORAL DISTRIBUTION OF PRECIPITATION CHEMISTRY ACROSS MARYLAND IN 1984, VOLUME 2
C. Maxwell and S. Mahn Sep. 1987 442 p Sponsored by Maryland Power Plant Research Program, Annapolis
(PB88-148937; PPRP/AD-87-10-Vol-2) Avail: NTIS HC A19/MF A01 CSCL 13B

Presented are: Summary statistics; January through March (total precipitation, average concentrations, pH, and total depositions); April through June (total precipitation, average concentrations, pH, and total depositions); July through September (total precipitation, average concentrations, pH, and total deposition); October through December (total precipitation, average concentrations, pH, and total depositions); January through June (total precipitation, average concentrations, pH, and total depositions); July through December (total precipitation, average concentrations, pH, and total depositions); and monthly total precipitation, average concentrations, pH, and total depositions. GRA

N88-21597# Oak Ridge National Lab., Tenn.
REPORT OF ATMOSPHERIC-CANOPY EXCHANGE PANEL
S. E. Lindberg, P. J. Samson, and J. F. Hornig May 1987 4 p Presented at the DOE Meterology Workshop, Lake Placid, N.Y., 1 Oct. 1985 Prepared in cooperation with National Center for Atmospheric Research, Boulder, Colo.; Dartmouth Coll., Hanover, N.H.
(Contract DE-AC05-84OR-21400)
(DE88-004478; CONF-8510250-2) Avail: NTIS HC A02/MF A01

The objectives of the Panel were to consider the exchange of the most basic constituents which define air/surface interactions (e.g., momentum, heat, water vapor) and determine limitations in our ability to measure and model these interactions on the scale of leaves to trees. We then considered specific atmospheric constituents both deposited to and emitted from the canopy, defined limitations of current approaches, and listed needs for new research to better understand, measure, and predict these interactions with forest canopies over a similar scale. Finally, we defined problems and developed approaches for dealing with the issue of providing landscape scale estimates of air/canopy exchanges. To tie these thoughts together, we developed a research program to deal with the major research needs perceived by the group. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-21598*# Florida Atlantic Univ., Boca Raton. Dept. of Physics.
GROUND-BASED COLUMN ABUNDANCE MEASUREMENTS OF ATMOSPHERIC HYDROXYL Semiannual Status Report, period ending 1 Jun. 1988
Clyde R. Burnett 26 Apr. 1988 15 p
(Grant NAGw-989)
(NASA-CR-182676; NAS 1.26:182676) Avail: NTIS HC A03/MF A01 CSCL 04A

The preliminary results of ground-based OH column abundance measurements from Truk, Federated States of Micronesia, are contained. These are the first OH column measurements from the tropics, and constitute a significant contribution to the OH data base. Comparisons of tropical OH behavior with the extensive mid-latitude observations serve as a critical test of the current understanding of the HO (sub x) photochemistry and its relationship to the other major chemical families. The quasi-biennial oscillation (QBO) in tropical stratospheric winds exerts a major influence on the Hadley cell vertical transport. Related QBOs in total O3 and in stratospheric H2O were identified, but QBO effects on other stratospheric species are still unknown. The solar tide in the tropics produces a diurnal surface pressure variation of 2 to 3 mb; its effect on OH photochemistry in the stratosphere may be significant. Author

N88-21599# Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Physical Research Dept.
COMBINED AERODYNAMIC SIZE, CHARGE-TO-MASS, AND VELOCITY MEASUREMENTS OF AEROSOL PARTICLES
R. Hunik and A. J. vanLoon, ed. 1987 13 p
(ST-Rept-Vol-5-No-4; B8727826; ISBN-90-353-0051-3; ISSN-0167-8590; ETN-88-91744) Avail: NTIS HC A03/MF A01

A method for the determination of the aerodynamic size, charge-to-mass ratio and velocity of aerosol particles is described. The method involves the application of acoustic and/or alternating electric fields over the measuring volume of a Laser Doppler Anemometer (LDA). The induced oscillating motion of an aerosol particle passing this measuring volume causes a frequency-modulated LDA signal. The characteristics of the oscillations and hence the aerodynamic size and charge-to-mass, as well as the velocity of the aerosol particle, can be determined after Fourier transformation of the signals. Experimental results regarding monodisperse particles show that not only histograms of aerodynamic sizes, charges and velocities but also, e.g., turbulences and charges as a function of aerodynamic sizes can easily be determined. ESA

N88-21600# Danish Meteorological Inst., Copenhagen. Div. of Geophysics.
MAGNETIC RESULTS, 1985
1987 43 p
(ISBN-8-77-478282-7; ETN-88-91878) Avail: NTIS HC A03/MF A01

The results of the standard observations carried out at the magnetic laboratory during 1985 are presented. The measurements show hourly means of horizontal and vertical intensity and hourly means of magnetic declination. Diurnal extreme values and mean diurnal inequalities are also given. Annual mean values for 1891 to 1980 are presented. ESA

N88-21601*# Harvard Univ., Cambridge, Mass. Dept. of Earth and Planetary Sciences.
ISOTOPIC AND CHEMICAL STUDIES OF EARLY CRUSTAL METASEDIMENTARY ROCKS Final Technical Report
Stein B. Jacobsen 9 May 1988 43 p
(Grant NAG9-90)
(NASA-CR-182711; NAS 1.26:182711) Avail: NTIS HC A03/MF A01 CSCL 08G

The aim, within the bounds of the Early Crustal Genesis Project, was the isotopic and chemical study of selected early crustal meta-sedimentary rocks. Western Australia was chosen as the first field area to examine, as the Yilgarn and Pilbara Blocks comprise one of the largest and most varied Precambrian terranes. Furthermore, the Western Gneiss Terrane (on the western flank of the Yilgarn Block) and the Pilbara Block are both non-greenstone in character; these types of terrane were relatively neglected, but are of great significance in the understanding of early crustal meta-sediments. The meta-sediments of aluminous or peraluminous character, commonly also enriched in Mg and/or Fe relative to the more common pelitic meta-sediments, and at many locations, deficient in one or more of the elements Ca, N, and K, were initially chosen. Author

N88-21602# Woods Hole Oceanographic Institution, Mass.
TECTONICS AND THREE-DIMENSIONAL STRUCTURE OF SPREADING CENTERS: MICROEARTHQUAKE STUDIES AND TOMOGRAPHIC INVERSIONS Ph.D. Thesis
D. R. Toomey Sep. 1987 214 p Sponsored by National Science Foundation, Washington, D.C. Prepared in cooperation with Massachusetts Institute of Technology, Cambridge
(Grants NSF EAR-80-18805; NSF EAR-82-18357)
(PB88-163290; WHOI-87-35) Avail: NTIS HC A10/MF A01 CSCL 08K

Two-thirds of the Earth's surface has been formed along a global system of spreading centers that are presently manifested in several different structural forms, including the classic rift valley of the mid-Atlantic Ridge, the more morphologically subdued East Pacific Rise, and the pronounced en echelon structure of the Reykjanes Peninsula within southwestern Iceland. Each of these spreading centers is investigated with microearthquake studies or tomographic inversion of travel times. Results of these studies are used to constrain the spatial variability of physical properties and processes beneath the axis of spreading and together with other observations, the temporal characteristics of crustal accretion and rifting. GRA

N88-21603 National Physical Lab., Teddington (England). Div. of Quantum Metrology.
CORRECTIONS FOR DIFFERENTIAL SCATTERING BY AEROSOLS IN THE MEASUREMENT OF OZONE BY DIAL
M. J. T. Milton Jul. 1987 19 p
(NPL-QU-78; ISSN-0309-3050; ETN-88-92074) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 OLW, United Kingdom

An empirical method for the calculation of corrections for aerosol differential absorption and backscatter in tropospheric ozone measurement is presented. The method makes the minimum number of assumptions possible in order to perform the calculation and depends only on knowing the meteorological visibility and the backscatter phase function. A more sophisticated method was used for calculating corrections to measurements in the upper boundary layer, but involves making different assumptions, which are untested in the troposphere. An example of the variation of the absorption correction is given. It can be seen that the lowest values are obtained for small wavelength differences at short wavelengths. This trend is demonstrated at all visibilities. ESA

N88-21604# Rome Univ. (Italy). Dipt. di Fisica.
PRELIMINARY COMPARISON OF SOME COINCIDENCE METHODS FOR GRAVITATIONAL WAVE DETECTORS [ESAME COMPARATIVO PRELIMINARE DI ALCUNI METODI DI COINCIDENZA PER RIVELATORI DI ONDE GRAVITAZIONALI]
Giovanni Vittorio Pallotino 11 Jan. 1988 13 p In ITALIAN
(Nota-Interna-903; ETN-88-92257) Avail: NTIS HC A03/MF A01

Methods used to improve the signal to noise ratio of experimental data from gravitational wave detectors functioning in time coincidence are discussed. The case in which the same gravitational pulse creates two responses of different amplitude is examined. A table giving the distribution in a simulation experiment is presented. The analysis of the distribution allows the determination of the probability that events of given characteristics were random. ESA

N88-21605*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTICAL PROPERTIES OF SOUTHERN HEMISPHERE AEROSOLS: REPORT OF THE JOINT CSIRO/NASA STUDY Final Report
John L. Gras, C. Martin Platt, R. Milton Huffaker, William D. Jones, and Michael J. Kavaya (Coherent Technologies, Inc., Boulder, Colo.) Feb. 1988 156 p
(Contract NAS8-36722)
(NASA-CR-179287; NAS 1.26:179287; CTI-TR-8801) Avail: NTIS HC A08/MF A01 CSCL 04A

This study was made in support of the LAWS and GLOBE programs, which aim to design a suitable Doppler lidar system for measuring global winds from a satellite. Observations were taken from 5 deg S to 45 deg S along and off the E and SE Australian coast, thus obtaining representative samples over a large latitude range. Observations were made between 0 and 6 km altitude of aerosol physical and chemical properties in situ from the CSIRO F-27 aircraft; of lidar backscatter coefficients at 10.6 micron wavelength from the F-27 aircraft; of lidar backscatter profiles at 0.694 microns at Sale, SE Australia; and of lidar backscatter profiles at 0.532 microns at Cowley Beach, NE Australia. Both calculations and observations in the free troposphere gave a backscatter coefficient of 1-2 x 10 to the -11/m/sr at 10.6 microns, although the accuracies of the instruments were marginal at this level. Equivalent figures were 2-8 x 10 to the -9/m/sr (aerosol) and 9 x 10 to the -9 to 2 x 10 to the -8/m/sr (lidar) at 0.694 microns wavelength at Sale; and 3.7 x 10 to the -9/m/sr (aerosol) and 10 to the -8 to 10 to the -7/m/sr (lidar) at 0.532 microns wavelength at Cowley Beach. The measured backscatter coefficients at 0.694 and 0.532 microns were consistently higher than the values calculated from aerosol size distributions by factors of typically 2 to 10. Author

N88-21606*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE EXPERIMENTS WITH PARTICLE ACCELERATORS (SEPAC): DESCRIPTION OF INSTRUMENTATION
W. W. L. Taylor, W. T. Roberts, D. L. Reasoner, C. R. Chappell, B. B. Baker, J. L. Burch, W. C. Gibson, R. K. Black, W. M. Tomlinson, and J. R. Bounds (General Digital Industries, Inc., Huntsville, Ala.) et al. Dec. 1987 68 p
(Contract NAS8-32580)
(NASA-TM-89728; NAS 1.15:89728) Avail: NTIS HC A04/MF A01 CSCL 04A

SEPAC (Space Experiments with Particle Accelerators) flew on Spacelab 1 (SL 1) in November and December 1983. SEPAC is a joint U.S.-Japan investigation of the interaction of electron, plasma, and neutral beams with the ionosphere, atmosphere and magnetosphere. It is scheduled to fly again on Atlas 1 in August 1990. On SL 1, SEPAC used an electron accelerator, a plasma accelerator, and neutral gas source as active elements and an array of diagnostics to investigate the interactions. For Atlas 1, the plasma accelerator will be replaced by a plasma contactor and charge collection devices to improve vehicle charging neutralization. This paper describes the SEPAC instrumentation in detail for the SL 1 and Atlas 1 flights and includes a bibliography of SEPAC papers. Author

N88-21343# Joint Publications Research Service, Arlington, Va.
PHYSICAL PROCESSES FOR MAINTAINING MEAN MERIDIONAL AND ZONAL CIRCULATION OF ATMOSPHERE IN MIDDLE LATITUDES, VOLUME 1 Abstract Only
Qiushi Chen *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 22 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 2, Jun 1987 p 167-175 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21344# Joint Publications Research Service, Arlington, Va.
NUMERICAL SIMULATION OF GENERATION OF MESOSCALE CONVECTIVE SYSTEMS IN LARGE-SCALE ENVIRONMENT Abstract Only
Daqing Xia *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 23 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 2, Jun. 1987 p 185-194 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21345# Joint Publications Research Service, Arlington, Va.
PHYSICAL PROCESS FOR MAINTENANCE OF MEAN MERIDIONAL AND ZONAL CIRCULATION OF ATMOSPHERE IN MIDDLE LATITUDES, VOLUME 2 Abstract Only
Qiushi Chen *In its* JPRS Report: Science and Technology.

China 2 Dec. 1987 p 24 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 237-246 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21537 Centre National de la Recherche Scientifique, Paris (France). Inst. National des Sciences de l'Univers.
INTRODUCTION TO THE DYNAMICS OF THE OCEAN AND THE ATMOSPHERE [INTRODUCTION A LA DYNAMIQUE DE L'OCEAN ET DE L'ATMOSPHERE]
Andre Berroir *In* CNES, Climatology and Space Observations Sep. 1987 p 19-31 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21548 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE EARTH RADIATION BUDGET AND ITS SPATIAL AND TEMPORAL VARIATIONS
Robert S. Kandel *In* CNES, Climatology and Space Observations Sep. 1987 p 259-310 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21550 California Univ., San Diego, La Jolla. California Space Inst.
NET RADIATIVE FLUX AT THE EARTH SURFACE: ESTIMATION FROM SATELLITE OBSERVATIONS
Catherine Gautier *In* CNES, Climatology and Space Observations Sep. 1987 p 371-382 (For primary document see N88-21536 14-42)
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N88-21551 California Univ., San Diego, La Jolla. California Space Inst.
SATELLITE ESTIMATIONS OF THE SOLAR RADIATION FLUX AT THE SURFACE
Catherine Gautier *In* CNES, Climatology and Space Observations Sep. 1987 p 383-405 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21553 Institut National de la Recherche Agronomique, Paris (France).
MODELING SURFACE EXCHANGES: THE SOIL-VEGETATION-ATMOSPHERE CONTINUUM [MODELISATION DES ECHANGES DE SURFACE: CONTINUUM SOL-PLANTE-ATMOSPHERE]
A. D. Perrier *In* CNES, Climatology and Space Observations Sep. 1987 p 423-456 In FRENCH (For primary document see N88-21536 14-42)
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N88-21554 Meteorological Office, Bracknell (England).
AN INTRODUCTION TO THE PARAMETERIZATION OF LAND-SURFACE PROCESSES
D. J. Carson *In* CNES, Climatology and Space Observations Sep. 1987 p 457-502 (For primary document see N88-21536 14-42)
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N88-21555 Centre National de Recherches Meteorologiques, Toulouse (France).
CONTINENTAL SURFACE PROCESSES AND WATER CYCLE [PROCESSUS DE SURFACE CONTINENTALE ET CYCLE DE L'EAU]
Jean-Claude Andre *In* CNES, Climatology and Space Observations Sep. 1987 p 503-514 In FRENCH (For primary document see N88-21536 14-42)
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N88-21556 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
SENSITIVITY OF GENERAL CIRCULATION MODELS TO SURFACE PROCESSES [SENSIBILITE DES MODELES DE CIRCULATION GENERALE AUX PROCESSUS DE SURFACE]
K. Laval *In* CNES, Climatology and Space Observations Sep. 1987 p 515-530 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21557 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT FROM SATELLITES OF LAND SURFACE PARAMETERS AND FLUXES IN THE THERMAL INFRARED BANDS: PROBLEMS AND METHODS
F. Becker *In* CNES, Climatology and Space Observations Sep. 1987 p 531-576 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21565 Centre National de la Recherche Scientifique, Paris (France).
EQUATORIAL DYNAMICS AND OCEAN-ATMOSPHERE COUPLING
Pascale Delecluse *In* CNES, Climatology and Space Observations Sep. 1987 p 665-700 In FRENCH (For primary document see N88-21536 14-42)
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47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-21607*# Applied Research Corp., Landover, Md.
SATELLITE RAINFALL RETRIEVAL BY LOGISTIC REGRESSION Final Report
Long S. Chiu Sep. 1986 101 p
(Contract NAS5-29271)
(NASA-CR-180485; NAS 1.26:180485) Avail: NTIS HC A06/MF A01 CSCL 04B

The potential use of logistic regression in rainfall estimation from satellite measurements is investigated. Satellite measurements provide covariate information in terms of radiances from different remote sensors.The logistic regression technique can effectively accommodate many covariates and test their significance in the estimation. The outcome from the logistical model is the probability that the rainrate of a satellite pixel is above a certain threshold. By varying the thresholds, a rainrate histogram can be obtained, from which the mean and the variant can be estimated. A logistical model is developed and applied to rainfall data collected during GATE, using as covariates the fractional rain area and a radiance measurement which is deduced from a microwave temperature-rainrate relation. It is demonstrated that the fractional rain area is an important covariate in the model, consistent with the use of the so-called Area Time Integral in estimating total rain volume in other studies. To calibrate the logistical model, simulated rain fields generated by rainfield models with prescribed parameters are needed. A stringent test of the logistical model is its ability to recover the prescribed parameters of simulated rain fields. A rain field simulation model which preserves the fractional rain area and lognormality of rainrates as found in GATE is developed. A stochastic regression model of branching and immigration whose solutions are lognormally distributed in some asymptotic limits has also been developed.
Author

N88-21608*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
GLOBAL METEOROLOGICAL DATA FACILITY FOR REAL-TIME FIELD EXPERIMENTS SUPPORT AND GUIDANCE
Mark C. Shipham, Scott T. Shipley, and Charles R. Trepte (SASC Technologies, Inc., Hampton, Va.) May 1988 26 p
(NASA-TM-4023; L-16391; NAS 1.15:4023) Avail: NTIS HC A03/MF A01 CSCL 04B

A Global Meteorological Data Facility (GMDF) has been constructed to provide economical real-time meteorological support to atmospheric field experiments. After collection and analysis of meteorological data sets at a central station, tailored meteorological products are transmitted to experiment field sites using conventional ground link or satellite communication techniques. The GMDF supported the Global Tropospheric Experiment Amazon Boundary Layer Experiment (GTE-ABLE II) based in Manaus, Brazil, during July and August 1985; an arctic airborne lidar survey mission for the Polar Stratospheric Clouds (PSC) experiment during January 1986; and the Genesis of Atlantic Lows Experiment (GALE) during January, February and March 1986. GMDF structure is similar to the UNIDATA concept, including meteorological data from the Zephyr Weather Transmission Service, a mode AAA GOES downlink, and dedicated processors for image manipulation, transmission and display. The GMDF improved field experiment operations in general, with the greatest benefits arising from the ability to communicate with field personnel in real time. Author

N88-21609 Oklahoma Univ., Norman.
ANALYSIS OF WINTER SEASON PRECIPITATION BANDS OVER THE SOUTHERN PLAINS Ph.D. Thesis
Gregory Paul Byrd 1987 206 p
Avail: Univ. Microfilms Order No. DA8725316

An extensive analysis of precipitation bands associated with winter season overrunning events in the Southern Plains is presented. The primary motivation is an investigation of the relevance of conditional symmetric instability (CSI) theory to banded precipitation events. This is accomplished by means of a statistical composite study of events of differing degrees of bandedness, using synoptic sounding data. A more detailed look at the kinematic and dynamic processes associated with bands is accomplished by radar Doppler case study analysis of two snowband events over central Oklahoma: 31 January 1985 and 7 February 1986. The composite study shows that it is difficult to distinguish between environments of banded and nonbanded cases on the basis of shear and buoyancy parameters. Statistically significant differences do occur when shear and buoyancy effects are combined in an evaluation of CSI, with banded events showing greater instability. The case studies show two possible scenarios for forcing of overrunning banded events. On 31 January, CSI is shown to be the dominant forcing mechanism, in the presence of strong convective stability and weak frontogenetical forcing. The second case shows much greater organization of the frontogenetical forcing and associated response which correlated well with the region of banded activity. The presence of CSI in this case probably enhanced the response to frontogenesis. Dissert. Abstr.

N88-21610# Environmental Technical Applications Center, Scott AFB, Ill.
REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS, LORING AFB, MAINE, PARTS A - F
19 Oct. 1987 291 p
(AD-A188201; USAFETAC/DS-87/067) Avail: NTIS HC A13/MF A01 CSCL 04B

The revised uniform summary of Surface Weather Observation (SWO) contains the following: weather conditions and atmospheric phenomena summaries; precipitation, snowfall, and snow depth summaries; surface wind summaries; ceiling versus visibility and sky cover summaries; temperature and relative humidity summaries; and pressure summaries, are presented. GRA

N88-21611# Naval Postgraduate School, Monterey, Calif.
TROPICAL AND MONSOONAL STUDIES Final Report, Jun. 1984 - 30 Nov. 1987
Chic-Pei Chang and Roger T. Williams Jan. 1988 171 p
(Grant NSF ATM-83-15175)
(AD-A188387; NPS-63-88-001) Avail: NTIS HC A08/MF A01 CSCL 04B

A variety of large-scale motions in the tropics and subtropics is studied, particularly those associated with the Asian monsoon circulations. It consists of four parts: (1) theoretical studies of planetary scale motion forced by tropical heating: The effects of vertical shear, vertical differential damping and planetary boundary layer were found to influence the forcing of midlatitude motions by tropical heat sources. In addition, the vertical interaction of simple modes may be responsible for the maintenance of the eastward propagating 30 to 50 day oscillations; (2) Observational studies of planetary scale motions: The day-to-day variation of the East Asian Jet was found to correlate positively with that of the tropical divergent flow south of it, suggesting the importance of tropical forcing through the local Hadley cell. The transient forcing of time-mean planetary scale circulation was also studied using a nine-year data set; (3) Theoretical studies of zonal asymmetry: Several differences between parallel flow and non-parallel flow instabilities in terms of spatial and time growth rates were found using the two-scale technique; (4) Studies of the Mei-Yu system of the East Asian summer monsoon: A numerical experiment suggested that the Low-Level Jet Associated with Mei-Yu fronts receives energy through an equatorward, convection-driven secondary circulation which is quite different from the cross-frontal circulation associated with dry fronts. GRA

N88-21612*# Caelum Research Corp., Silver Spring, Md.
TABULATION OF Mie SCATTERING CALCULATION RESULTS FOR MICROWAVE RADIATIVE TRANSFER MODELING
Hwa-Young M. Yeh and N. Prasad (General Sciences Corp., Laurel, Md.) Mar. 1988 86 p
(Contracts NAS5-30143; NAS5-28795)
(NASA-CR-4130; NAS 1.26:4130; Rept-88B0116) Avail: NTIS HC A05/MF A01 CSCL 04B

In microwave radiative transfer model simulations, the Mie calculations usually consume the majority of the computer time necessary for the calculations (70 to 86 percent for frequencies ranging from 6.6 to 183 GHz). For a large array of atmospheric profiles, the repeated calculations of the Mie codes make the radiative transfer computations not only expensive, but sometimes impossible. It is desirable, therefore, to develop a set of Mie tables to replace the Mie codes for the designated ranges of temperature and frequency in the microwave radiative transfer calculation. Results of using the Mie tables in the transfer calculations show that the total CPU time (IBM 3081) used for the modeling simulation is reduced by a factor of 7 to 16, depending on the frequency. The tables are tested by computing the upwelling radiance of 144 atmospheric profiles generated by a 3-D cloud model (Tao, 1986). Results are compared with those using Mie quantities computed from the Mie codes. The bias and root-mean-square deviation (RMSD) of the model results using the Mie tables, in general, are less than 1 K except for 37 and 90 GHz. Overall, neither the bias nor RMSD is worse than 1.7 K for any frequency and any viewing angle. Author

N88-21613# Royal Netherlands Meteorological Inst., De Bilt. Dept. of Oceanographic Research.
CLIMATOLOGICAL DATA OF THE NETHERLANDS LIGHTVESSELS OVER THE PERIOD 1949-1980
C. G. Korevaar 1987 200 p
(KNMI-WR-87-9; B8727397; ISSN-0169-1651; ETN-88-91802)
Copyright Avail: NTIS HC A09/MF A01

Tables with temperature, wind, wave, visibility, and current data for the North Sea for 1949 to 1980 are presented. The observations are compared with those for 1859 to 1883, 1884 to 1909, and 1910 to 1940. ESA

N88-21614# Royal Netherlands Meteorological Inst., De Bilt. Dynamical Meteorology Dept.
NONLINEAR NORMAL MODE INITIALIZATION OF A LIMITED AREA MODEL USING NONSTATIONARY ROSSBY MODES

S. J. Bijlsma 1987 25 p
(KNMI-WR-87-10; B8731413; ISSN-0169-1651; ETN-88-91804)
Copyright Avail: NTIS HC A03/MF A01

For the application of the nonlinear normal mode method to the initialization of a limited area prediction model, the construction of the normal modes of the linearized model equations is treated. Instead of setting Coriolis parameter equal to a constant value in the equations, leading to stationary Rossby modes, a simple extension, by modifying the linearized model equations so that they admit solutions with nonzero Rossby frequencies, is considered. The results are compared with those using a nonlinear normal mode initialization with constant Coriolis parameter. They show that the two methods are virtually identical in their effect upon the initial fields and upon their development during the first hours of the forecast. ESA

N88-21615# Stockholm Univ. (Sweden). Dept. of Meteorology.
LOCAL METEOROLOGICAL PROCESSES AND AIR MASS ORIGIN DURING A CLOUD CHEMICAL FIELD EXPERIMENT ON ARESKUTAN, SWEDEN, IN SUMMER 1986
K. Birgitta Johansson 12 Oct. 1987 179 p Sponsored by the Knut and Alice Wallenbergs Foundation and the Swedish Natural Science Council
(AP-28; ISSN-0280-4441; ETN-88-91881) Avail: NTIS HC A09/MF A01

During a cloud chemical experiment on a mountain, meteorological observations were done in order to study the local meteorological processes present during the experiment, and to identify air mass changes. A wide range of air masses passed the site during the experiment period, as indicated by trajectories and variations in measured chemical and physical parameters. An attempt to estimate the entrainment of surrounding air into the clouds does not give any useful results. This is also the case with estimates of the liquid water content in clouds from the observed visibility. The correlation between the observed visibility and the visibility derived from the aerosol light scattering coefficient is good, though. The meteorological observations are presented in diagrams together with a day-to-day description of the synoptic weather situations. ESA

N88-21616# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
SOME MODELS FOR RAIN AND CLOUD ATTENUATION OF MILLIMETER WAVES
E. J. Dutton, H. T. Dougherty, and D. C. Hyovalti Nov. 1987 44 p
(PB88-160809; NTIA-87-225) Avail: NTIS HC A03/MF A01 CSCL 04B

In the first section of this report, rainfall observational data are processed by least-squares curve-fitting to call attention to some of the desirable aspects of such fitting. The curve-fitting techniques are illustrated for annual rainfall and worst month rainfall distributions, but are as readily applicable for distributions of rain-caused attenuation or scattering. GRA

N88-21617# National Oceanic and Atmospheric Administration, Boulder, Colo. Air Resources Lab.
CLIMATIC SUMMARIES OF OCEAN WEATHER STATIONS
H. F. Diaz, C. S. Ramage, S. D. Woodruff, and T. S. Parker Sep. 1987 336 p Prepared in cooperation with Colorado Univ., Boulder
(PB88-162920) Avail: NTIS HC A15/MF A01 CSCL 04B

Surface and upper air climatological summaries for 16 Ocean Weather Stations(OWS) are presented. Periods of record for surface data vary from 7 years for OWS X to more than 30 years for OWS C, M, and P. OWS T operated primarily during the summer typhoon season (May to November). Valid upper air records are generally of equal or lesser duration than those taken at the surface. The interval of time covered extends from 1945 for the earliest starting OWS to 1982 for a few OWS, some of which are still operating. The purpose of the special report is to make available to the scientific community high-quality climatological data over generally fixed ocean areas for comparison with data from traveling merchant ships and for comparison with profiles derived from satellite observations. GRA

N88-21618# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
ANALYSIS OF METEOROLOGICAL CONDITIONS AND HAZE DISTRIBUTION FOR THE SECOND ARCTIC GAS AND AEROSOL SAMPLING PROGRAM (AGASP 2), MARCH-APRIL 1986
G. A. Herbert, H. A. Bridgman, R. C. Schnell, B. A. Bodhaine, and S. J. Oltmans Nov. 1987 74 p Prepared in cooperation with Colorado Univ., Boulder
(PB88-164140; NOAA-TM-ERL-ARL-158) Avail: NTIS HC A04/MF A01 CSCL 04B

The second Arctic Gas and Aerosol Sampling Program (AGASP 2) was conducted across the non-Soviet Arctic in March and April 1986, to study the aerosol, chemical, and optical properties of Arctic haze. One component of the program was conducted with a specially instrumented NOAA WP-3D aircraft. Measurements of wind, pressure, temperature, ozone, water vapor, condensation nuclei concentration, and aerosol scattering extinction were used to determine the locations of significant haze layers. The first three NOAA WP-3D research flights were conducted north of Point Barrow, Alaska, and over the Beaufort Sea northeast of Barter Island, Alaska. The following three research flights sampled conditions in the high Arctic, near Alert, Northwest Territories, Canada. GRA

N88-21619# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Sciences Group.
DISTRIBUTION OF SUMMERTIME LIGHTNING AS A FUNCTION OF LOW-LEVEL WIND FLOW IN CENTRAL FLORIDA
Raul E. Lopez and Ronald L. Holle Jul. 1987 48 p
(PB88-160759; NOAA-TM-ERL-ESG-28) Avail: NTIS HC A03/MF A01 CSCL 04B

The effects of different prevailing wind flow regimes on the spatial and temporal distributions of cloud-ground lightning are studied using flash data for three summers in central Florida (total 646,839 flashes). The flow regimes are characterized by the mean 1000 to 700 mb wind direction. Classification as calm, onshore/offshore, and parallel/antiparallel is based on the morning sounding at Kennedy Space Center. The results indicate that prevailing winds determine both the spatial pattern and magnitude of the lightning activity. GRA

N88-21620# Woods Hole Oceanographic Institution, Mass.
TROPIC HEAT MR (METEOROLOGICAL RECORDER) METEOROLOGICAL DATA (APRIL 1984 - JUNE 1985)
R. E. Payne Nov. 1987 30 p
(Grant NSF OCE-83-10982)
(PB88-161286; WHOI-87-47) Avail: NTIS HC A03/MF A01 CSCL 04B

The report presents meteorological data recorded by the MR on the three deployments of Tropic Heat moorings, within 1.5 degrees north and south of the equator at approximately 134 degrees and 140 degrees west. Parameters recorded included vector, averaged wind speed and direction, air and sea temperatures, insolation, barometric pressure, and relative humidity although not all parameters were recorded on all deployments. The deployments were all nominally six months. Data recovery was poor because of instrument and mooring failures. GRA

N88-21621# Lawrence Livermore National Lab., Calif.
OBSERVATIONAL AND THEORETICAL STUDIES OF GREENHOUSE CLIMATE EFFECTS
K. E. Taylor and S. L. Grotch Jan. 1988 16 p Presented at the 8th Miami International Conference on Alternative Energy Sources, Miami Beach, Fla., 14 Dec. 1987
(Contract W-7405-eng-48)
(DE88-006237; UCRL-98087; CONF-871204-7) Avail: NTIS HC A03/MF A01

Atmospheric CO2 concentration has increased by about 25% over the last 150 years and will continue to increase as a result of fossil fuel combustion. Enhancement of the atmospheric effect by elevated levels of CO2 and other trace gases may over the next century increase global average surface air temperature by a few degrees Celsius. Even eliminating emissions of CO2 will not prevent global climate change because the combined greenhouse effect of less abundant but radiatively important gases such as methane and chlorocarbons is likely to be just as large as the impact of projected increases in carbon dioxide concentration. Quantitative estimates of future warming that could result from continued increases in greenhouse gas concentrations come from sophisticated mathematical models, which are the modern climatologists' primary prognostic tool. The current limitations and uncertains in these model results, however, prevent definitive predictions of the regional climatic responses that make up the projected global change. Deficiencies in the historical climate record prevent confirmation of the climate model predictions, but future research offers the potential for improved understanding. DOE

N88-21622# National Oceanic and Atmospheric Administration, Norman, Okla. National Severe Storms Lab.
DEVELOPMENT AND TESTING OF THE GUST FRONT ALGORITHM Interim Report
Arthur Witt and Steven D. Smith Nov. 1987 40 p
(Contract DTFA01-80-Y-10524)
(AD-A189722; DOT/FAA/PS-87/4) Avail: NTIS HC A03/MF A01 CSCL 04B

Threshold changes, additions, and other refinements to the original version of the Gust Front Algorithm are documented. Threshold changes include a minimum velocity difference threshold, the maximum azimuthal separation between vectors, and maximum range separation. Additions include gust front tracking and forecasting in Cartesian coordinates, vertical continuity checks of gust front features to reduce the occurrence of false detections, and horizontal wind estimation both ahead and behind a detected gust front using single Doppler velocity data. Results of these additions and the effects of threshold changes on detection capability are presented for several case studies. GRA

N88-21342# Joint Publications Research Service, Arlington, Va.
ATMOSPHERIC ATTENUATION OF NEAR INFRARED RADIATION PROPAGATING THROUGH FOG Abstract Only
Zhengfang Song *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 17 Transl. into ENGLISH from Hongwai Yanjiu (Shanghai, Peoples Republic of China), v. 6A, no. 4, Aug. 1987 p 315-319 Original language document was announced in IAA as A88-10549 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21346# Joint Publications Research Service, Arlington, Va.
NUMERICAL SIMULATION OF MEDIUM SCALE DISTURBANCE ON MEIYU FRONT Abstract Only
Kun Gao *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 25 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 289-296 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21347# Joint Publications Research Service, Arlington, Va.
STUDY OF PASSAGES OF CROSS-EQUATORIAL CURRENT DURING SOUTHERN MONSOON Abstract Only
Zengzhong Li *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 26 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 313-319 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21348# Joint Publications Research Service, Arlington, Va.
INTERMITTENCY OF ATMOSPHERIC TURBULENCE-APPLICATION OF LYAPUNOV EXPONENTS AND FRACTIONAL DIMENSION Abstract Only
Qingqiu Shao *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 27 Transl. into ENGLISH from Daqi Kexue (Beijing, Peoples Republic of China), v. 11, no. 3, Sep. 1987 p 331-336 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21538 Direction de la Meteorologie Nationale, Paris (France).
THE WORLD CLIMATE RESEARCH PROGRAM [LE PROGRAMME MONDIAL DE RECHERCHE SUR LE CLIMAT]
P. Waldteufel *In* CNES, Climatology and Space Observations Sep. 1987 p 33-53 In FRENCH (For primary document see N88-21536 14-42)
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N88-21540 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE ATMOSPHERE AS A COMPONENT OF THE CLIMATE SYSTEM: STRUCTURE AND VARIABILITY
Robert Sadourny *In* CNES, Climatology and Space Observations Sep. 1987 p 73-100 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21541 European Centre for Medium-Range Weather Forecasts, Reading (England).
ADIABETIC FORMATION OF LARGE-SCALE MODELS OF THE ATMOSPHERE
D. M. Burridge *In* CNES, Climatology and Space Observations Sep. 1987 p 101-145 (For primary document see N88-21536 14-42)
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N88-21542 European Centre for Medium-Range Weather Forecasts, Reading (England).
REPRESENTATION OF PHYSICAL PROCESSES IN GLOBAL ATMOSPHERIC MODELS
G. Sommeria *In* CNES, Climatology and Space Observations Sep. 1987 p 147-179 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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N88-21543 Direction de la Meteorologie Nationale, Paris (France).
PARAMETERIZATION OF RADIATION IN A GENERAL CIRCULATION MODEL
J. F. Geleyn *In* CNES, Climatology and Space Observations Sep. 1987 p 181-189 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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N88-21544 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
ASSIMILATION OF METEOROLOGICAL OBSERVATIONS
Olivier Talagrand *In* CNES, Climatology and Space Observations Sep. 1987 p 191-206 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
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N88-21545 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
CARBON DIOXIDE AND CLIMATE
Robert S. Kandel *In* CNES, Climatology and Space Observations Sep. 1987 p 207-217 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21546 Centre National de Recherches Meteorologiques, Toulouse (France).
SEA SURFACE TEMPERATURES OF WINTER 1982-83 AND THEIR EFFECT ON ATMOSPHERIC CIRCULATION
J. F. Royer *In* CNES, Climatology and Space Observations Sep. 1987 p 219-227 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21549 Centre National d'Etudes Spatiales, Toulouse (France). Lab. d'Optique Atmospherique.
THE ROLE OF RADIATION TRANSFER IN CLIMATE MODIFICATION [LE ROLE DU TRANSFERT RADIATIF DANS LA MODELISATION DU CLIMAT]
Y. Fouquart *In its* Climatology and Space Observations Sep. 1987 p 311-369 In FRENCH (For primary document see N88-21536 14-42)
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N88-21558 Ecole Polytechnique, Palaiseau (France). Lab. de Meteorologie Dynamique.
THE INTERNATIONAL SATELLITE LAND-SURFACE CLIMATOLOGY PROJECT (ISLSCP)
S. I. Rasool *In* CNES, Climatology and Space Observations Sep. 1987 p 577-581 (For primary document see N88-21536 14-42)
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N88-21560 Centre National de Recherches Meteorologiques, Toulouse (France).
THE HAPEX-MOBILHY PROGRAM [LE PROGRAMME HAPEX-MOBILHY]
Jean-Claude Andre *In* CNES, Climatology and Space Observations Sep. 1987 p 599-608 In FRENCH (For primary document see N88-21536 14-42)
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48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-21623# Perceptics Corp., Knoxville, Tenn.,
OCEANOGRAPHIC EXPORT SYSTEM DEVELOPMENT, YEAR 1 Final Report
M. G. Thomason Nov. 1987 16 p Prepared in cooperation with Tennessee Univ., Knoxville
(Contract N00014-87-C-6001)
(AD-A189134) Avail: NTIS HC A03/MF A01 CSCL 08C

An expert system is being developed to assist in analyzing and interpreting mesoscale features in the Atlantic Ocean off the U.S. east coast. A previous report, NORDA TR-148 discusses the approach and gives a statement of a base of knowledge about warm- and cold-core rings (formation, expected movement, evolution and decay) and the Gulf Stream. There is not total agreement by oceanographic experts in all aspects of mesoscale features. The results of a small-sample survey reported in NORDA TN-350 indicate predominant agreement with the statements in the knowledge base, although there are cases in which the reviewers show sharp division. This system was not designed as a stand alone simulation to give accurate, long term predictions, it should be regarded as forming hypotheses about the evolution of mesoscale features which must then be validated as much as possible by evidence in satellite data. The system must be viewed as one component in the development of a larger, knowledge-based package for image analysis. GRA

N88-21624# Royal Netherlands Meteorological Inst., De Bilt. Div. of Oceanographic Research.
AN IMPROVED WIND INPUT SOURCE TERM FOR THIRD GENERATION OCEAN WAVE MODELING
L. Yan 1987 24 p
(KNMI-WR-87-8; B8723164; ISSN-0169-1651; ETN-88-91801)
Copyright Avail: NTIS HC A03/MF A01

An expression for approximating the growth rate of wind generated surface gravity waves is presented. It combines Komen's (1984) and Plant's (1982) relation. It has the form Beta = omega (0.04 U sup asterisk sq/c sq cos theta + 0.00544 U sup asterisk / cos theta + 0.000055 cos theta - 0.000311). The effect of incorporating this formula in the WAM wave growth model is compared with the standard WAM model. It is found that the shifting of the spectral peak towards the low frequencies is slower and that the height of the peak decreases. However, there is no strong influence on the energy gain by waves. ESA

N88-21625# Centre National d'Etudes Spatiales, Toulouse (France). Centre Spatial.
MARGINAL ICE ZONE EXPERIMENT (MIZEX) 1984 VARAN-S DATA SET
N. Lannelongue, D. Vaillant, J. Perbos, and W. J. Campbell Nov. 1985 61 p
(ETN-88-92032) Avail: NTIS HC A04/MF A01

Side-looking airborne radar was installed in a B-17 aircraft to map ice, at 200 to 3000 m altitude with 20 km swath width. The X-band digital radar provided 5 mosaics of 100 km by 100 km. The long range and low speed of the B17 are highly advantageous for ice mapping. ESA

N88-21626*# Massachusetts Inst. of Tech., Cambridge.
MASS, HEAT AND NUTRIENT FLUXES IN THE ATLANTIC OCEAN DETERMINED BY INVERSE METHODS Ph.D. Thesis
Stephen Rich Rintoul Mar. 1988 287 p Prepared in cooperation with Woods Hole Oceanographic Institution, Mass.
(Grant NAG5-534)
(NASA-CR-180535; NAS 1.26:180535) Copyright Avail: NTIS HC A13/MF A01 CSCL 08C

Inverse methods are applied to historical hydrographic data to address two aspects of the general circulation of the Atlantic Ocean. The method allows conservation statements for mass and other properties, along with a variety of other constraints, to be combined in a dynamically consistent way to estimate the absolute velocity field and associated property transports. The method was first used to examine the exchange of mass and heat between the South Atlantic and the neighboring ocean basins. The second problem addressed concerns the circulation and property fluxes across the 24 and 36 deg N in the subtropical North Atlantic. Conservation statements are considered for the nutrients as well as mass, and the nutrients are found to contribute significant information independent of temperature and salinity. Author

N88-21627# Delaware Univ., Newark. Sea Grant Coll. Program.
YABLED CRUISES PART 2: DATA FROM YABLED-17 THROUGH YABLED-26, JANUARY-OCTOBER 1985 Oceanographic Data Report No. 5
C. H. Culberson, J. R. Pennock, B. W. Lee, R. B. Biggs, and T. M. Church Oct. 1987 67 p Sponsored in part by NSF, Washington, D.C.
(Grant NA83AA-D-00017)
(PB88-163597; DEL-SG-17-87) Avail: NTIS HC A04/MF A01 CSCL 08C

The report presents physical, chemical, and biological data collected during 9 cruises on the Delaware River and Bay from January to October 1985. These cruises, designated YABLED, covered the entire salinity gradient in the estuary from freshwater in the river near Philadelphia to seawater at the entrance of the bay. GRA

N88-21628# National Oceanic and Atmospheric Administration, Miami, Fla. Oceanographic and Meteorological Labs.
CURRENT VELOCITY AND HYDROGRAPHIC OBSERVATIONS IN THE STRAITS OF FLORIDA, THE CARIBBEAN SEA AND OFFSHORE OF THE ANTILLEAN ARCHIPELAGO: SUBTROPICAL ATLANTIC CLIMATE STUDIES (STACS) 1986
A. M. Wilburn, E. Johns, and M. Bushnell Nov. 1987 253 p (PB88-160767; NOAA-DR-ERL-AOML-10) Avail: NTIS HC A12/MF A01 CSCL 08C

The primary objectives of the Subtropical Atlantic Climate Study (STACS) are to increase our understanding of the dynamics of the North Atlantic subtropical gyre and to define which oceanographic processes are important to meridional heat flux. As the Florida Current has been shown to play an important role in the flux, the initial emphasis of STACS was to develop the capability to monitor the variability of oceanic heat and mass transport in the Straits of Florida. GRA

N88-21629# National Oceanic and Atmospheric Administration, Miami, Fla. Oceanographic and Meteorological Labs.
CTD/O2 DATA COLLECTED IN 1985 AND 1986 FOR EPOCS (EQUATORIAL PACIFIC OCEAN CLIMATE STUDIES)
C. Roffer and D. W. Behringer Oct. 1987 272 p (PB88-160775; NOAA-DR-ERL-AOML-9) Avail: NTIS HC A12/MF A01 CSCL 08C

A summary of CTD measurements collected during four cruises in 1985 and 1986, as part of the Equatorial Pacific Ocean Climate Studies (EPOCS), is presented. These cruises continued the EPOCS program efforts along 110 degrees W and 85 degrees W, and extended the research area southeast along 15 degrees S. Station locations and profiles of temperature, salinity, and sigma T are plotted for each cast. Dissolved oxygen bottle values, theta-s diagrams, and temperature and salinity sections are shown. GRA

N88-21630# Skidaway Inst. of Oceanography, Savannah, Ga.
BIOLOGICAL PROCESSES IN THE WATER COLUMN OF THE SOUTH ATLANTIC BIGHT: ZOOPLANKTON RESPONSES Progress Report
G. A. Paffenhoefer 16 Dec. 1987 8 p
(Contract DE-FG09-85ER-60354)
(DE88-004811; DOE/ER-60354/3) Avail: NTIS HC A02/MF A01

The studies on which we report in the following segments represent interdisciplinary efforts to understand interactions of physical, chemical and biological processes on the southeastern continental shelf of the USA. The Georgia Bight Experiment was designed to determine the physical forces responsible for upwelling on the northeastern Florida and Georgia shelf during summer, trajectories and fate of those upwellings, and major chemical and biological processes therein. DOE

N88-21631# Georgia Univ., Athens. Inst. of Ecology.
PRODUCTION AND TURNOVER OF SUSPENDED ORGANIC DETRITUS IN THE COASTAL WATER OF THE SOUTHEASTERN CONTINENTAL SHELF Progress Report, 1 Jun. 1987 - 31 May 1988
L. R. Pomeroy 1 Dec. 1987 206 p
(Contract DE-FG09-86ER-60451)
(DE88-005118; DOE/ER-60451/2) Avail: NTIS HC A10

This project describes specific aspects of microbial processes and related phenomena that influence the fate of particulate organic materials naturally produced on the continental shelf. SPREX is a cooperative study of the spring removal of water from the southeastern continental shelf. Our contribution included studies of respiratory rate of microorganisms, measurement of bacterial biomass and bacterial biomass production and measurement of carbon and nitrogen content of total seston. BIOTRANS is a cooperative study of the cycle of nitrogen and the flux of energy in the coastal water of the Georgia bight. We are measuring bacterial numbers and biomass production and bacterial respiration in the coastal water. Our studies provide us with an estimate of the rate of turnover of organic matter produced on the inner continental shelf. Marked differences occurred in the efficiency of bacterial utilization of dissolved organic matter between the coastal water and the more oceanic water of the middle and outer continental shelf. FLEX is a cooperative study of the removal of coastal water from the shelf as a result of the change from the summer to the fall wind regime in the southeast. DOE

N88-21562 Florida State Univ., Tallahassee.
LARGE-SCALE OCEAN DYNAMICS
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 631-642 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21563 Florida State Univ., Tallahassee.
THE MAIN OCEAN THERMOCLINE
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 643-654 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21564 Florida State Univ., Tallahassee.
WIND AND BUOYANCY DRIVEN OCEAN CIRCULATION
Benoit Cushman-Roisin *In* CNES, Climatology and Space Observations Sep. 1987 p 655-663 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21566 Paris VI Univ. (France).
OCEAN EDDIES [TOURBILLONS OCEANIQUES]
Christine Provost *In* CNES, Climatology and Space Observations Sep. 1987 p 701-762 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21567 Centre National d'Etudes Spatiales, Toulouse (France). Groupe de Recherches de Geodesie Spatiale.
STUDY OF THE DYNAMIC TOPOGRAPHY OF OCEANS BY MEANS OF SATELLITE ALTIMETRY [ETUDE DE LA TOPOGRAPHIE DYNAMIQUE DES OCEANS PAR ALTIMETRIE SATELLITAIRE]
J. F. Minster *In its* Climatology and Space Observations Sep. 1987 p 763-813 In FRENCH (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21568 Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
BASIC NETWORKS OF TOGA: DETERMINATION OF THERMAL PROFILES BY XBT AND OF SEA LEVEL BY TIDE GAGE
J. R. Donguy *In* CNES, Climatology and Space Observations Sep. 1987 p 815-819 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21569 Scott Polar Research Inst., Cambridge (England).
LARGE ICE MASSES: CHARACTERISTICS, BEHAVIOUR AND RELATION TO CLIMATE
David J. Drewry *In* CNES, Climatology and Space Observations Sep. 1987 p 823-834 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21571 Laboratoire d'Oceanographie Dynamique et de Climatologie, Paris (France).
ELEMENTS OF SEA ICE DYNAMICS AND THERMODYNAMICS
J. C. Gascard *In* CNES, Climatology and Space Observations

Sep. 1987 p 849-884 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21572 Max-Planck-Inst. fuer Meteorologie, Hamburg (West Germany).
SEA ICE OBSERVATIONS AND MODELS
P. Lemke *In* CNES, Climatology and Space Observations Sep. 1987 p 885-895 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

N88-21573 Laboratoire d'Oceanographie Dynamique et de Climatologie, Paris (France).
THE GREENLAND SEA PROJECT: THE ARCTEMIZ PROJECT
J. C. Gascard *In* CNES, Climatology and Space Observations Sep. 1987 p 897-916 (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

51 LIFE SCIENCES (GENERAL)

N88-21632# California Univ., Berkeley. Lawrence Berkeley Lab.
BIOLOGY AND MEDICINE DIVISION Annual Report, 1986
Apr. 1987 292 p
(Contract DE-AC03-76SF-00098)
(DE87-009280; LBL-22300) Avail: NTIS HC A13/MF A01

The Biology and Medicine Division continues to make important contributions in scientific areas in which it has a long-established leadership role. For 50 years the Division has pioneered in the application of radioisotopes and charged particles to biology and medicine. There is a growing emphasis on cellular and molecular applications in the work of all the Division's research groups. The powerful tools of genetic engineering, the use of recombinant products, the analytical application of DNA probes, and the use of restriction fragment length polymorphic DNA are described and proposed for increasing use in the future. DOE

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-21633# Southampton Univ. (England). Inst. of Sound and Vibration Research.
FURTHER INVESTIGATION OF TESTS FOR SUSCEPTIBILITY TO NOISE-INDUCED HEARING LOSS
B. W. Lawton and D. W. Robinson Jul. 1987 52 p
(Contract MOD-2040/0366(APRE))
(ISVR-TR-149; ETN-88-91904) Avail: NTIS HC A04/MF A01

Thirty men highly resistant to noise, were subjected to hearing tests as in Lawton and Robinson (1986). Results suggest that susceptibility to noise-induced hearing loss is likely to be associated with poor temporal integration and with abnormal tone-on-tone masking discrimination; possibly also with weak acoustic reflex action. By carrying out the three tests required to determine the above measures at the pre-exposure stage, in addition to the usual tests of hearing sensitivity by pure-tone audiometry, it would be possible to earmark systematically a proportion of those tested as being the most likely to be noise-susceptible. This process is probabilistic rather than deterministic and the number so earmarked is a matter of judgement: there is no sharp cut off on any of the measures that divides a population unambiguously into susceptible and not susceptible. Short forms of the tests, suitable for initial screening, could be developed. ESA

N88-21634# Southampton Univ. (England). Inst. of Sound and Vibration Research.
VISUALIZATION OF THE AIR FLOWING THROUGH A DYNAMIC MODEL OF THE VOCAL FOLDS
Christine H. Shadle, Stephen J. Elliot, and Philip A. Nelson Oct. 1987 34 p Sponsored by NATO and a Hunt Fellowship
(ISVR-TR-154; ETN-88-91905) Avail: NTIS HC A03/MF A01

Aerodynamic effects of vocal fold vibration were investigated with a life-size dynamic model of the vocal folds and surrounding vocal tract. Pressure-flow measurements were made for 4 fixed positions of the model (glottal areas of 6, 12, 18, 24 mm sq) to enable comparison of the model to other static studies. These show that although the entrance to the model glottis was unrealistically abrupt, the model nevertheless exhibits realistic pressure-flow characteristics. Flow downstream of the glottis was visualized while one fold vibrated against the other with a forced sinusoidal excitation. Photographs were taken at 45 deg intervals throughout the cycle for 2 flowrates (200, 350 cc/sec) 2 fundamental frequencies (80, 100 Hz), and 2 supraglottal acoustic impedances. The photos show development of a jet within each glottal cycle, demonstrating an insufficiency of static models in which phase angle is not a parameter. Lengthening the supraglottal tract so that FO approximately equaled the tract's quarter-wavelength resonance tends to make the jet form earlier in the cycle, and cannot be adequately explained. ESA

N88-21635# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
VALIDATION OF MATHEMATICAL MODEL PREDICTIONS OF IMMERSION SURVIVAL TIMES
P. J. Sowood, J. R. Allan, and J. B. Cohen May 1987 26 p
(IAM-652; BR102901; ETN-88-92052) Copyright Avail: NTIS HC A03/MF A01

The survival times of aircrew immersed in cold water wearing standard aircrew equipment assemblies were estimated using a mathematical model of human thermoregulation. The accuracy of the model was validated by comparing its predictions of metabolic rates, surface heat loss, skin temperatures, and core temperatures with those measured during a series of cold water immersions using subjects wearing a range of protective clothing. The results indicate that the model predicts overall change in core temperature with sufficient accuracy to allow it to be used to predict realistic and safe estimates of survival time. ESA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-21636# Technische Hogeschool Twente, Enschede (Netherlands).
QUASI-LOGLINEAR MODELS FOR TEST AND ITEM ANALYSIS Ph.D. Thesis
Hendrikus Kelderman 1987 187 p
(B8716249; ETN-88-91838) Avail: NTIS HC A09/MF A01

The connection between discrete data analysis by the use of loglinear models and the item-response model of Rasch (1960, 1966) is studied. It is shown that the dichotomous Rasch model can be formulated as a certain quasi-loglinear model. This yields a methodological framework to test the Rasch model and to apply it to practical measurement problems. An algorithm that can handle data sets of real life size was developed. The quasi-loglinear Rasch model is applied to two psychometric problems, the detection of biased items and the equating of test. ESA

N88-21637# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Abteilung Luft- und Raumfahrtpsychologie.
CONSTRUCTION OF A MULTIDIMENSIONAL QUESTIONNAIRE TO DETERMINE INTERINDIVIDUAL DIFFERENCES IN CONTROLLING ATTENTION

Reinhold Mergenthal Oct. 1987 61 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-45; ISSN-0171-1342; ETN-88-92114) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 20.50 Deutsche marks

A questionnaire on work behavior was constructed in order to isolate parameters of work style which may correlate with the occurrence or the avoidance of human errors. The philosophy behind the questions and analysis of the responses are discussed. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-21638# Anthropology Research Project, Yellow Springs, Ohio.
FIT EVALUATION OF FEMALE BODY ARMOR Final Report, Jul. 1986 - Feb. 1987
Gregory F. Zehner, Cay Ervin, Kathleen M. Robinette, and Patricia Daziens Jun. 1987 63 p
(Contract F33615-85-C-0531)
(AD-A188721; AAMRL-TR-87-046) Avail: NTIS HC A04/MF A01 CSCL 05H

The object of this research was to evaluate the current issue MS-1 (Natick) female body armor vest, and to examine design modifications which would enhance the protection level by improving the fit. Subjects in the study were 37 female Air Force police trainees selected to represent a range of body sizes found in the overall USAF population. The MS-1 and two commercially available vests were evaluated for fit, comfort, and coverage in a series of measurements and observations. On the whole, the MS-1 vest compared favorable with the commercial garments. Some design changes are suggested to improve fit and coverage. GRA

N88-21639# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
MASKING OF MOTION CUES BY RANDOM MOTION: COMPARISON OF HUMAN PERFORMANCE WITH A SIGNAL DETECTION MODEL Thesis
Glenn Lewis Greig Jan. 1988 343 p Sponsored by Natural Sciences and Engineering Research Council of Canada
(UTIAS-313; ISSN-0082-5255) Avail: NTIS HC A15/MF A01

An investigation of human sensitivity to whole-body motion is described. Specifically, the ability of human subjects to detect a sinusoidal motion signal superimposed on a background of random motion is discussed. The purpose was to determine the conditions in which motion cues are masked or hidden by concurrent random motion. The results have applications to flight simulation, and will also be of interest to other researchers working in the area of human perceptual performance. It is proposed that for the situation under study, motion perception is a signal-in-noise detection process which can be modelled using signal detection theory. A brief review of signal detection theory is provided. Three ideal detectors adapted from the literature on auditory perception were proposed as potential models for motion perception. Three motion perception experiments were run. All three experiments provided an estimate of the slope of the psychometric curve. Of the three ideal detectors considered, the energy detector agrees best with the experimental data. The data are compared in detail with the predictions of the energy detector. A simplified method for estimating signal detectability in arbitrary conditions is presented. Finally, the implications of the results for flight simulation are discussed. Author

N88-21640# Transportation Systems Center, Cambridge, Mass.
ANALYSIS OF HEAD RESPONSE TO TORSO ACCELERATION. VOLUME 1: DEVELOPMENT OF PERFORMANCE REQUIREMENTS
C. H. Spenny Dec. 1987 182 p Sponsored by National Highway Traffic Safety Administration, Washington, D.C.
(PB88-156757; DOT-TSC-NHTSA-86-5-Vol-1; DOT-HS-807-159-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 05H

Performance requirements are developed which define the kinematic and kinetic response of the head for a seated subject exposed to frontal, lateral or oblique impact. Response is expressed in terms of variables which are readily measured in an anthropomorphic dummy and which are useful in injury prediction. The performance requirements are based on volunteer tests in which a four-point restraint system and a singular type of impact profile are employed. Other tests are used to evaluate the effects of variation in impact profile, type of restraint system and level of muscle activity. Author

N88-21641 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
IMPROVING THE MAN-MACHINE INTERFACE TO ROBOTIC SYSTEMS
D. R. Manning, P. T. Neale, R. E. Rengger, and P. K. T. Vaswani Sep. 1987 31 p
(NPL-DITC-100/87; ISSN-0262-5369; ETN-88-91911) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 0LW, United Kingdom

Robotic and telerobotic systems are surveyed, emphasizing their control by human operator and their man-machine interface (MMI). Outstanding MMI problems are discussed and suggestions are made for future research in that area. Human operator control of manipulators is identified as meriting particular attention and the freehand control technique is explained. The development of a simple laboratory rig to demonstrate the principles of freehand control is described together with a qualitative assessment of experience gained with it. ESA

N88-21642# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmedizin.
PSYCHOPHYSICAL LOAD OF GLIDER PILOTS ON LONG-DURATION FLIGHTS Thesis - Bonn Univ.
Wolfgang Koll Oct. 1987 113 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-38; ISSN-0171-1342; ETN-88-92110) Avail: NTIS HC A06/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000, Cologne, Federal Republic of Germany, 38.50 deutsche marks

In order to estimate pilot load on long duration flights, 9 glider pilots made 16 flights of up to 6 hours duration, mostly long-distance flights. There was continuous recording of the heart rate and flight protocol including altitude cockpit temperature and g-load. Tests to assess fatigue (self-rating) and performance were carried out at different times. There is no indication of continuous or sudden fatigue or any change of the performance level. Particularly risky situations excluded, the load of the cardiovascular system appears to be lower than previously assumed. ESA

N88-21643# Sandia National Labs., Albuquerque, N. Mex.
HUMAN INTERFACES IN REMOTE DRIVING
D. E. McGovern 1988 33 p Presented at the IGC Conference, Bedford, Mass., 20 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006843; SAND-88-0562C; CONF-880359-1) Avail: NTIS HC A03/MF A01

Driving vehicles through remote control (teleoperation) can allow the human operator to take actions at a distance. Human effectiveness can be projected into locations which may be hazardous. In order for the operator to control the motion of these vehicles, knowledge of the vehicle environment and status need to be available. This requires a system consisting of vehicle,

communication link and human operator. Much work has been done in vehicle and communication system design but comparatively little effort has been devoted to the human interface. In this paper, experimental studies of remote driving are reviewed to approach an understanding of what is known. Summary data are presented for experimental work performed at Sandia National Laboratories in vehicle vision systems. This information is combined with the experience base developed through several years of work with teleoperated vehicles to identify the major areas requiring additional development effort. DOE

N88-21644# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
FURTHER DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SPECIFICATION OF IMMERSION CLOTHING INSULATION
P. A. Hayes and J. B. Cohen Mar. 1987 35 p
(IAM-653; BR102902; ETN-88-92053) Copyright Avail: NTIS HC A03/MF A01

Changes to the FORTRAN code and method of use of the Wissler model of thermoregulation are discussed. Inclusions make possible the simulation of counter-current heat conservation processes, water leakage into dry suits, and alternative ways of distributing the subcutaneous fat thickness dependent on methods of measurement and calculation of the mean weighted thickness of fat. The way in which the model should be used to obtain reproducible and accurate simulations is discussed in relation to the production of survival curves used for the specification of immersion protection clothing assemblies. ESA

N88-21645# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
IMPLEMENTATION OF A VISUAL SERVOING SYSTEM FOR EVALUATION OF ROBOTIC REFUELING APPLICATIONS M.S. Thesis
Mikel M. Miller Dec. 1987 177 p
(AD-A189676; AFIT/GE/ENG/87D-45) Avail: NTIS HC A09/MF A01 CSCL 12I

The threats of dangerous environments and projected cuts in military personnel, combined with advances in robotics and sensors, have caught the attention of the United States Air Force. The Flight Dynamics Laboratory at Wright-Patterson Air Force Base has been conducting research into concepts for performing aircraft ground refueling using robotic systems. The main sensor for a robotic refueler applications is vision. Visual information received from TV camera mounted to the refueling boom, provides the feedback data necessary for employing visual servo control techniques. This feedback data, the refueling port's centroid and depth, is used to visually guide the robot refueler to the refueling port. This research effort designs and integrates a visual servo control scheme for a PUMA 560 robot arm that derives its control information from a Machine Intelligence Corporation vision system. GRA

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N88-21646*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CARE 3 USER'S WORKSHOP
Apr. 1988 160 p Workshop held in Hampton, Va., 6-7 Oct. 1987; sponsored by NASA, Washington
(NASA-CP-10011; NAS 1.55:10011) Avail: NTIS HC A08/MF A01 CSCL 12A

A user's workshop for CARE 3, a reliability assessment tool designed and developed especially for the evaluation of high reliability fault tolerant digital systems, was held at NASA Langley Research Center on October 6 to 7, 1987. The main purpose of the workshop was to assess the evolutionary status of CARE 3. The activities of the workshop are documented and papers are included by user's of CARE 3 and NASA. Features and limitations of CARE 3 and comparisons to other tools are presented. The conclusions to a workshop questionaire are also discussed. Author

N88-21647*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SENSITIVITY OF CONTROL-AUGMENTED STRUCTURE OBTAINED BY A SYSTEM DECOMPOSITION METHOD
Jaroslaw SobieszczanskiSobieski, Christina L. Bloebaum, and Prabhat Hajela (Florida Univ., Gainesville.) Jan. 1988 11 p Presented at the AIAA ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988
(NASA-TM-100535; NAS 1.15:100535; AIAA-88-2205) Avail: NTIS HC A03/MF A01 CSCL 12A

The verification of a method for computing sensitivity derivatives of a coupled system is presented. The method deals with a system whose analysis can be partitioned into subsets that correspond to disciplines and/or physical subsystems that exchange input-output data with each other. The method uses the partial sensitivity derivatives of the output with respect to input obtained for each subset separately to assemble a set of linear, simultaneous, algebraic equations that are solved for the derivatives of the coupled system response. This sensitivity analysis is verified using an example of a cantilever beam augmented with an active control system to limit the beam's dynamic displacements under an excitation force. The verification shows good agreement of the method with reference data obtained by a finite difference technique involving entire system analysis. The usefulness of a system sensitivity method in optimization applications by employing a piecewise-linear approach to the same numerical example is demonstrated. The method's principal merits are its intrinsically superior accuracy in comparison with the finite difference technique, and its compatibility with the traditional division of work in complex engineering tasks among specialty groups. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-21648# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
ATOMIC MULTIREADER REGISTER
Lefteris M. Kirousis, Evangelos Kranakis, and Paul M. B. Vitanyi May 1987 32 p Submitted for publication
(Contracts N00014-85-K-0168; DAAG29-84-K-0058; N00014-83-K-0125; Grant NSF DCR-83-02391)
(CWI-CS-R8722; B8723970; ETN-88-91767) Copyright Avail: NTIS HC A03/MF A01

Two implementations for atomic, shared, asynchronous, wait-free registers are given: (1) Implementation of an atomic, 1-writer, 1-reader, b-bit register from O(b) safe, boolean registers (i.e., from scratch). The solution uses neither repeated writing of the input nor repeated reading of the output. (2) Implementation of an atomic, 1-writer, n-reader, multibit register from O(n sq) atomic, 1-writer, 1-reader, multibit registers. Both constructions rely on the same idea. Implementation of (2) can be considered a

generalization of (1). The results show how to construct atomic, multireader registers from elementary hardware like flip-flops.
ESA

N88-21649# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
RANDOM ACCESS MEMORY TESTING: THEORY AND PRACTICE. THE GAINS OF FAULT MODELING
P. K. Veenstra Oct. 1986 125 p
(EUT-86-E-161; ISBN-9-06-144161-7; ISSN-0167-9708; ETN-88-91808) Avail: NTIS HC A06/MF A01

It is shown that functional testing of RAMs can be improved with the aid of fault models. Fault coverage increases when algorithms are used based on a well-defined fault model. A considerable reduction of the test time is possible, since the optimized patterns require substantially fewer memory accesses. The fault coverage of the stuck-at model turns out to be too limited if the memories contain hardly detectable coupling failures, especially caused by faults in the decoder or read/write logic. Ad-hoc procedures like GALPAT, Shifted Diagonals, show a decreased performance if a fault does not suit their specific detection sensitivity. Addressing order does not influence the properties of the patterns for permanent faults. Although the Marching 0's/1's procedure displays excellent performance for nearly good devices, a drop occurs for memories with coupling faults due to the limitations of the fault model. Design errors and processing shortcomings result frequently in time-dependent faults.
ESA

N88-21650# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
HIGHER LEVELS OF A SILICON COMPILER M.S. Thesis
L. Stok, R. vandenBorn, and G. L. J. M. Janssen Nov. 1986 96 p
(EUT-86-E-163; ISBN-9-06-144163-3; ISSN-0167-9708; ETN-88-91810) Avail: NTIS HC A05/MF A01

An approach to map an algorithmic description onto a hardware structure is presented. The algorithm is parsed and translated into a syntax tree. From this tree a special data flow graph, the demand graph, is derived. On this graph several optimizations can be done to make the graph structure better realizable. Inefficiencies introduced by the designer may also be removed. It is essential that the optimizations transform a demand graph into a semantically equivalent demand graph. The demand graph is compiled into a hardware structure consisting of a data path and a finite state machine. The compilation is done by generating alternative implementations, using a dynamic programming technique, and choosing the optimal implementation. This choice is made with the information provided by the module library, concerning the area, dissipation, and speed of the modules. The algorithms are coded in CommonLisp.
ESA

N88-21651# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
IMPLEMENTATION AND EVALUATION OF A COMBINED TEST-ERROR CORRECTION PROCEDURE FOR MEMORIES WITH DEFECTS
A. J. Vinck, J. PinedadeGyvez, and K. A. Post Feb. 1987 27 p
(EUT-87-E-169; ISBN-9-06-144169-2; ISSN-0167-9708; ETN-88-91816) Avail: NTIS HC A03/MF A01

The application of simple parity check coding together with a test procedure to improve the Mean Time To Failure (MTTF) for memory systems with hard errors (defects) is discussed. The memory is said to be in failure if more errors are detected than can be corrected. The test procedure combines the idea of additive coding with simple parity checking. The complexity is proportional to the frequency of parity errors. The test procedure includes soft errors as well. The influence of coding on MTTF is calculated. The improvement in the MTTF for a 1 defect matching test strategy is proportional to sq rt N where N is the size of the memory in terms of the number of words. A hardware implementation at a gate level is given together with time delay simulation for a specific example.
ESA

N88-21652# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Computer Science.
PERFORMANCE ANALYSIS OF SLOTTED RING PROTOCOLS IN HIGH SPEED LOCAL AREA NETWORKS (HSLANS)
M. Zafirovic-Vukotic, I. G. Niemegeers, and D. Valk Oct. 1987 29 p
(INF-87-31; EL-080-87-47; ETN-88-91832) Avail: NTIS HC A03/MF A01

The performance of slotted ring protocols supporting integration of synchronous and asynchronous traffic in high speed local area networks is evaluated: the Cambridge Fast Ring, a variant of the Cambridge Fast Ring, and Orwell. The performance of their basic access mechanisms is compared and contrasted to the multiple token ring. The effect of uniframe scheme for supporting synchronous traffic is examined. The influence of system parameters and performance of the integrated services slotted ring protocols is evaluated.
ESA

N88-21653# Argonne National Lab., Ill.
ACTIVITIES AND OPERATIONS OF THE ADVANCED COMPUTING RESEARCH FACILITY, OCTOBER 1986-OCTOBER 1987
G. W. Pieper 1987 32 p
(Contract W-31-109-eng-38)
(DE88-006223; ANL-87-50) Avail: NTIS HC A03/MF A01

This paper contains a description of the work being carried out at the advanced computing research facility at Argonne National Laboratory. Topics covered are upgrading of computers, networking changes, algorithms, parallel programming, programming languages, and user training.
DOE

N88-21654*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, Calif.
THE PC/AT COMPATIBLE COMPUTER AS A MISSION CONTROL CENTER DISPLAY PROCESSOR AT AMES-DRYDEN FLIGHT RESEARCH FACILITY
Kevin R. Hammons May 1988 21 p Prepared for presentation at the AIAA 4th Flight Test Conference, San Diego, Calif., 18-20 May 1988
(NASA-TM-100426; H-1457; NAS 1.15:100426) Avail: NTIS HC A03/MF A01 CSCL 09B

Since 1982, the Western Aeronautical Test Range of the Ames-Dryden Flight Research Facility has been separating the data acquisition and processing function required on all telemetry pulse code modulation (PCM) data and the display processing function required in the flight research mission control centers (MCCs). These two functions historically have been done on the same set of superminicomputers remote from the MCCs. Removing the display processing function from the realm of the superminis or telemetry-radar acquisition and processing system (TRAPS) and out into the MCCs will allow the research engineers the flexibility to configure their own display processing system to optimize performance during a flight research mission. Meanwhile, the TRAPS will have more time to acquire data. One of the processors chosen is an IBM PC/AT compatible rack-mounted personal computer. This class and type machine will not only allow the transfer of the display processing function into the MCCs, but also allow the research engineers a personalized set of analytic and display tools for use on their own unique sets of data.
Author

N88-21655# Sheffield Univ. (England). Dept. of Control Engineering.
MICROPROCESSORS IN SPACE INSTRUMENTATION
M. P. Gough (Sussex Univ., Brighton, England) and L. J. C. Woolliscroft Oct. 1987 34 p Sponsored by the United Kingdom Science and Engineering Research Council and the University Grants Committee
(RR-321; ETN-88-92067) Avail: NTIS HC A03/MF A01

The level of integration of microprocessors with space instrumentation is reviewed. Their inclusion provides improved measurement resolution, improved reliability, a more efficient use of limited spacecraft resources, and provides control for complex

instruments. Microprocessors are relied on to perform mission critical calculations, while future uses involve increased on-board intelligence and on-board expert systems. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-21656# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
VERIFICATION OF AN ALGORITHM FOR LOG-TIME SORTING BY SQUARE COMPARISON
J. C. Mulder and W. P. Weijland Jun. 1987 28 p Submitted for publication
(ESPRIT Proj. 432)
(CWI-CS-R8729; B8723977; ETN-88-91774) Copyright Avail: NTIS HC A03/MF A01

A concurrent sorting algorithm called RANKSORT is presented. It can sort an input sequence of length n in log n time, using n sq processors. The algorithm is formally specified as a delay-intensive circuit. A formal correctness proof is given, using bisimulation semantics in the language algebra of communicating processes of Bergstra and Klop. The algorithm has area x sq = O (n sq log sup 4 n) complexity which is slightly suboptimal with respect to the lower bound of area x sq = Omega (n sq log n). ESA

N88-21657# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
OPTIMIZATION OF THE REAL LEVEL 2 BLAS ON THE CYBER 205
W. M. Lioen, M. Louter-Nool, and H. J. J. teRiele Jul. 1987 16 p Submitted for publication
(CWI-NM-R8715; B8729646; ETN-88-91787) Copyright Avail: NTIS HC A03/MF A01

The results of the implementation and optimization of the real Level 2 BLAS routines on the Cyber 205 vectorcomputer are presented. The Level 2 BLAS routines perform three types of matrix-vector operations: matrix-vector multiplication, rank-1 and rank-2 updates, and solution of triangular systems of equations. The performance of the routines varies between 60 and 80 percent of the maximum Cyber 205 performance, for general matrices of order 500, and for band matrices of order 30,000 with 6 nonzero diagonals. ESA

N88-21658# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
GENERATING LAYOUTS FOR RANDOM LOGIC: CELL GENERATION SCHEMES
R. J. vanEngelshoven and J. F. M. Theeuwen Nov. 1986 41 p
(EUT-86-E-164; ISBN-9-06-144164-1; ISSN-0167-9708; ETN-88-91811) Avail: NTIS HC A03/MF A01

Starting from a boolean expression the process of generating a linear transistor array, also called a cell, is described for NMOS. This result is used to obtain a practical method for generating CMOS cells. The adopted Depth First Search provides a clearly structured basic algorithm consisting of modules that can easily be adjusted or extended. In this way the cell generator may be tuned to calculate solutions in minimum cpu-time or solutions that need minimum area, or even have fitting dimensions regarding their surrounding cells. A data structure that makes it possible to modify the structure of the network without changing the implemented logic function is presented. This approach is then applied to the basic algorithm. ESA

N88-21659# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ESKISS: A PROGRAM FOR OPTIMAL STATE ASSIGNMENT M.S. Thesis
C. A. M. Oerlemans and J. F. M. Theeuwen Jan. 1987 73 p
(EUT-87-E-167; ISBN-9-06-144167-6; ISSN-0167-9708; ETN-88-91814) Avail: NTIS HC A04/MF A01

An algorithm ESKISS, that searches for an optimal encoding of the states with regard to the needed size of a PLA to implement the finite state machine (FSM) used in the functional description of VLSI circuits, is presented. The description of the FSM is given by means of a symbolic cover (state transition table) and is firstly minimized by the symbolic minimizer ESPRESSO. ESKISS generates state groups, containing states that show identical transitions in the transition table. Based on these state groups a relation can be stated, such that if the encodings of the states satisfy the relation, the assignment is optimal with regard to the size of the PLA. This relation is called the constraint relation. The ESKISS generates an encoding that satisfies this constraint relation. ESA

N88-21660# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
DASM: A TOOL FOR DECOMPOSITION AND ANALYSIS OF SEQUENTIAL MACHINES
Yibin Hou (Xian Jiaotong Univ., China) Mar. 1987 60 p
(EUT-87-E-170; ISBN-9-06-144170-6; ISSN-0167-9708; ETN-88-91817) Avail: NTIS HC A04/MF A01

A program package DASM for decompositions and analysis of sequential machines is described. It can deal with most functions and topics in the research and applications of machines. For each function of DASM, principle, algorithm, and an example are shown. Therefore, it is a useful tool for teaching, research, and industry applications related to machine theory. Because DASM works on the abstract mathematical level and the theory of machines has a considerable influence, not only on the development of computer systems and their associated languages and software, but also in biology, psychology, biochemistry etc., DASM can also used in any other area where machine thoery serves as a mathematical model. ESA

N88-21661# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Computer Science.
ITERATION OF TRANSFORMATION PASSES OVER ATTRIBUTED PROGRAM TREES
Henk Alblas Sep. 1987 50 p
(INF-87-28; ETN-88-91829) Avail: NTIS HC A03/MF A01

A strategy of repeatedly applying alternate attribute evaluation and tree transformation phases is discussed. An attribute evaluation phase consists of a sequence of passes over the tree. A tree transformation phase consists of a single pass, which is never interrupted for reevaluation purposes. Both phases can be performed in parallel. This strategy requires a distinction between consistent (i.e., correct) and approximate attribute values. Tree transformations can be considered safe if they guarantee that the attribute values everywhere in the program tree remain consistent or become at least approximations of the consistent values, so that subsequent transformations can be applied correctly. This attribute evaluation and tree transformation strategy shows similarities with the evaluation methods for circular attribute grammars. ESA

N88-21662# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
LINEAR PROGRAMMING ALONG THE TRAJECTORY OF THE PROBLEM
C. Roos 1987 18 p
(Rept-87-41; B8723343; ISSN-0920-8577; ETN-88-91850)
Copyright Avail: NTIS HC A03/MF A01

The map Tr (or trajectory, P) related to the unique point Tr (L) (at which the L (lower bound) potential of an interior point (Int (P)) of the feasible region of a linear programming problem attains its minimal value, is investigated. It is shown that Tr is differentiable, and that to each point of Int (P) which is reached by Tr, there corresponds a unique feasible solution of the dual problem (D) of (P). This can be used to show that Tr(L) converges to an optimal solution of (P) if L approaches the optimal value of (P). These

properties indicate that it must be possible to find an algorithm for solving (P) which is based on the use of the trajectory of (P). Such an algorithm is presented, and it is shown that it solves (P) in a number of steps which is bounded by O(ml), where l denotes the size of the problem. ESA

N88-21663# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
APPLICABILITY OF NONLINEAR PROGRAMMING IN DECISION SUPPORT SYSTEMS: REALIZATION OF USER-FRIENDLY SOFTWARE
Willeke Kribbe and Gerard vanderHoek 1987 18 p Presented at the Martin Beale Memorial Symposium, London, England, 6-8 Jul. 1987
(Rept-87-42; B8721712; ISSN-0920-8577; ETN-88-91851)
Copyright Avail: NTIS HC A03/MF A01

Problems encountered with the application of nonlinear models are reviewed. It is shown how, in a partitioned algorithm, information gathered during the execution of the problems can be used to adapt parameter values for the algorithm, or even to decide to use a different algorithm starting from this point. Such an approach was followed in the development of a system for nonlinear optimization. The algorithms in this system are based on algorithms for quadratic programming that were developed by Beale and Benveniste (1972, 1979). ESA

N88-21664# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
MULTIEXTREMAL OPTIMIZATION VIA ADAPTIVE PARTITION ALGORITHMS
Janos Pinter 1987 19 p
(Rept-87-44; B8725616; ISSN-0920-8577; ETN-88-91853)
Copyright Avail: NTIS HC A03/MF A01

A class of nongradient algorithms that perform adaptive partition and search of the feasible region HCR sup n on which a multiextremal function f is minimized is considered. Axiomatic requirements which assure global convergence of a prototype algorithm are formulated. The suggested approach is applicable (in different realizations) to rectangular, convex, and nonconvex sets H. ESA

N88-21665# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
DEFINITION AND DISPLAY OF PROFILED SWEEP-OBJECTS
Willem F. Bronsvoort, Peter R. vanNieuwenhuizen, and Frits H. Post 1987 29 p
(Rept-87-45; B8725617; ISSN-0920-8577; ETN-88-91854)
Copyright Avail: NTIS HC A03/MF A01

A class of free-form solids called profiled sweep objects is introduced. These are defined by 4 parametric curves: a 2D contour (cross-section), a 3D trajectory (spine), and 2 profile curves, which control the scaling of the contour as it moves along the trajectory. Subclasses of this are profiled prisms, which have a linear trajectory, and profiled generalized cylinders, which have an arbitrary 3D trajectory. An exact definition of profiled sweep-objects and their relation with common sweep-objects is presented. A method for the construction of planar approximations of these objects that can be used for fast display generation is given. Ray tracing algorithms that directly use the exact definition for high-quality are described. ESA

N88-21666# Groningen Rijksuniversiteit (Netherlands). Dept. of Mathematics and Computing Science.
ON THE DESIGN OF SOME SYSTOLIC ALGORITHMS
Jan L. A. vandeSnepscheut and Johan B. Swenker 9 Jun. 1987 17 p
(CS-8705; ETN-88-91863) Avail: NTIS HC A03/MF A01

Systolic algorithms and their design are introduced. A systolic algorithm is an algorithm that may efficiently be executed by an array of cells in the following way. Cells repeatedly execute a step. Steps are executed simultaneously by all cells. Each cell has local variables. During a step the local variables may be inspected and altered, and the local variables of neighboring processes may be inspected. The execution time of a step may not depend on the number of cells. Input to and output from the array of cells is handled through the local variables of a fixed, small set of designated cells. The programs derived consist of a loop. Each iteration of the loop is implemented by a step per cell. The iterated statement is a concurrent assignment statement. The number of components of the assignment equals the number of cells and, per step, each cell executes its component of the assignment statement. The problems tackled are recognition of palindromes, recognition of carres, and generation of polynomials for cyclic codes. ESA

N88-21667# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj.
MONTE CARLO MODIFIED METHOD FOR GREEN FUNCTION. ALGORITHM AND COMPUTER CODE FOR CALCULATIONS IN EQUAL MASS MANY-BODY SYSTEM
M. I. Polikarpov and L. V. Shevchenko 1987 30 p In RUSSIAN
(DE88-701114; ITEF-43(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

The description and the test program for the Monte-Carlo modified method for the Green functions are given. The program is designed for calculations in equal mass many-body systems with any interaction potential, which is assigned in the program. The number of particles in the program is a parameter, the form of the equations solved and calculated is unique for any number of particles. A pair Cornel potential to calculate systems consisting in 3, 6, 9, 12 light quarks is used for a concrete case given in the paper. As a result, energies of basic states, the wave function and the wave function square of the low state are calculated. DOE

N88-21668# Fondazione Ugo Bordoni, Rome (Italy).
SUPERCOMPUTER-AIDED GENERALIZED MIXER ANALYSIS AND OPTIMIZATION
Vittorio Rizzoli, Claudio Cecchetti, and Andrea Neri (Bologna Univ., Italy) Sep. 1986 8 p Presented at the European Microwave Conference, Dublin, Ireland, Sep. 1986 Sponsored in cooperation with the Italian Ministry of Public Education
(FUB-15-1986; ETN-88-91873) Avail: NTIS HC A02/MF A01

A direct harmonic-balance treatment of nonlinear circuits under multiple-frequency excitation with attractive cost-to-performance ratios was achieved using a VAX-11/750 computer. The application of such an approach to microwave mixers is presented, and a direct mixer optimization is demonstrated. ESA

N88-21669# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Regelung.
FORTRAN 77 ERROR HANDLING OF THE RASP LIBRARY
Martin Otter Sep. 1987 54 p
(DFVLR-Mitt-87-14; ISSN-0176-7739; ETN-88-91917) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 18.50 Deutsche marks

An error handling concept for FORTRAN 77 programs used in the control engineering subroutine library RASP is presented. The main ideas are explained and the user interface is described. ESA

N88-21670# Datamat Ingegneria dei Sistemi S.p.A., Rome (Italy).
SOFTWARE QUALITY ASSURANCE WORKSTATION Final Report
Paris, France ESA 6 Aug. 1987 55 p
(Contract ESTEC-6471/85-NL-MA)
(P-1124/RT-14791; ESA-CR(P)-2526; ETN-88-91965) Avail: NTIS HC A04/MF A01

A workstation for preparation of the software verification program, its execution, monitoring and reporting; preparation of software projects quality assurance plans, their execution, monitoring and reporting; and configuration management with

particular emphasis on non conformances management was developed. It helps users by maintaining a project library of all the relevant information thus allowing them to write or update each piece of information only once and having, in this way, updated all the documents that piece of information is relevant to. It also provides facilities to help the user in performing technical tasks by allowing on line retrieval of selected information either on the screen or in written reports. Procedures application and standards respect are enforced and uniform documentation is issued. The workstation may also be connected to a mainframe to act as a terminal or to transfer information; in this way it may become a part of a software engineering environment. ESA

N88-21671# CISI Ingenierie, Toulouse (France).
DESIGN METHOD FOR Ada PROGRAMS Final Report
Maurice Heitz and Pierre Vielcanet Paris, France ESA 27 Jul. 1987 37 p
(Contract ESA-6887/86-NL-MAC)
(ESA-CR(P)-2528; ETN-88-91966) Avail: NTIS HC A03/MF A01

A design method which complies with Ada concepts and the requirements of space applications was developed. Course material for this method for training European software engineers, analysts and system programmers was produced. The adoption of a common design method for Ada programs within the European space software community should lead the software teams of ESA contractors to better homogeneity in the production of their documentation materials, and improved communication (delivery of software documents, reviews). The design method called Hierarchical Object Oriented Design was selected by the Columbus project for the architectural design phase. The training material is needed since training in Ada (programming language and supporting tools) was already proposed by European software firms at a good level of commonality (provided by Ada standardization), and there was serious risks of ESA contractors developing their own Ada design method from their field practice. ESA

N88-21672# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Computer Science Dept.
[ACTIVITIES REPORT OF THE COMPUTER SCIENCE DEPARTMENT] Annual Report, 1986
Jun. 1987 15 p
(ETN-88-91980) Avail: NTIS HC A03/MF A01

Improvements of the numerical turbulence simulation code on the multi array processor facility; LEXAPO computer console operator aid expert system; parallel solving of the linear elasticity problem for a composite beam; and development of CAD/CAM facilities are described. ESA

N88-21673# Argonne National Lab., Ill.
A PARALLEL ALGORITHM FOR COMPUTING THE SINGULAR VALUE DECOMPOSITION OF A MATRIX
E. R. Jessup and D. C. Sorensen Dec. 1987 31 p
(Contract W-31109-eng-38)
(DE88-007059; ANL/MCS-TM-102) Avail: NTIS HC A03/MF A01

A parallel algorithm for computing the singular value decomposition will be presented. The basic step of the algorithm is a divide and conquer step based upon a rank one modification of a bidiagonal matrix. Numerical difficulties associated with forming the product of a matrix with its transpose are avoided and numerically stable formulae for obtaining left singular vectors after computing updated right singular vectors are derived. A deflation technique is described which together with a robust root finding method will assure computation of the singular values to full accuracy in the residuals and will also assure the orthogonality of the singular vectors. DOE

N88-21674# Royal Signals and Radar Establishment, Malvern (England).
PUBLIC TOOL INTERFACES FOR SOFTWARE DEVELOPMENT ENVIRONMENTS
M. Stanley, N. E. Peeling, and I. F. Currie Sep. 1987 40 p
(RSRE-87004; BR104022; ETN-88-91889) Copyright Avail: NTIS HC A03/MF A01

The problems of defining a portable public tools interface to underpin the software tools needed for the development and maintenance of software systems are discussed. A requirement specification is proposed, and the rationale behind the proposed requirements is explained. The rationale also suggests facilities and implementation features to enable the requirement to be met. It indicates that the requirement is not necessarily overambitious. ESA

N88-21675# Royal Aircraft Establishment, Farnborough (England).
THREE-DIMENSIONAL MESH-GENERATION AND PLOTTING ROUTINES FOR USE WITH A BOUNDARY ELEMENT PROGRAM (BIE3D)
K. W. Man and M. H. Aliabadi (Southampton Univ., England) Jul. 1986 27 p
(AD-A188079; RAE-TM-MAT-STR-1077; BR100384;
ETN-88-92039) Copyright Avail: NTIS HC A03/MF A01
CSCL 09B

Two computer programs were developed as data preparation tools for the three-dimensional boundary integral equation computer program. The first is a three-dimensional mesh generation program based on a semiautomatic subdivision technique similar to a two-dimensional finite element mesh generation procedure. The program is written in standard FORTRAN and is operational in a VAX computer. The second is a program for plotting the generated mesh. The plotting program is used to draw a three-dimensional view of the mesh of a problem. A generated mesh can be drawn so that its topology can be checked visually for anomalous points and incompatibility of elements. The program is written in BASIC and it runs interactively on a Hewlett-Packard HP2647F graphics terminal. Examples, instructions, and descriptions for input and output data file are presented in each case. ESA

N88-21676# Royal Signals and Radar Establishment, Malvern (England).
Ada TASKING IN Ten15
D. J. Tombs Oct. 1987 29 p
(RSRE-Memo-4074; BR104331; ETN-88-92050) Copyright
Avail: NTIS HC A03/MF A01

An Ada compiler which uses the Ten15 abstract machine as its target was developed. The Ten15 implementation of the tasking support for this compiler is described. With Ten15 the underlying hardware implementation maintains process scheduling, for all programs and independent of language, hence Ada tasking is considered only in terms of Ten15 processes. Each Ada operation is performed either directly as compiled Ten15 or by accessing a procedure from a Ten15 library suite which is incorporated into the compiled code as something nonlocal to the entire program. ESA

N88-21677# Royal Signals and Radar Establishment, Malvern (England).
THE SOFTWARE REPEATER (AN EXERCISE IN Z SPECIFICATION)
C. OHalloran Oct. 1987 24 p
(RSRE-Memo-4090; BR104504; ETN-88-92051) Copyright
Avail: NTIS HC A03/MF A01

The specification of a software repeater in a language known as Z is presented. The specification is refined into an implementation in the C programming language. The correctness of the implementation is shown by proof obligations and the program analysis tool Malpas. The C implementation was compiled and ran successfully on a 68010 processor. ESA

N88-21678# Sheffield Univ. (England). Dept. of Control Engineering.
IDENTIFICATION OF NONLINEAR OUTPUT-AFFINE SYSTEMS USING AN ORTHOGONAL LEAST SQUARES ALGORITHM
S. A. Billings, M. J. Korenberg (Queens Univ., Kingston, Ontario), and S. Chen Mar. 1987 12 p

(Grant SERC-GR/D/30587)
(RR-313; ETN-88-92060) Avail: NTIS HC A03/MF A01

The identification of a nonlinear output-affine difference equation model is considered. An orthogonal least squares algorithm which can determine which term to regress upon, detect significant terms in the model expansion, and provide the final parameter estimates is derived. It is shown that the orthogonal property of the algorithm results in a particularly simple estimation routine and simulated examples are included to illustrate the techniques. ESA

N88-21679# Sheffield Univ. (England). Dept. of Control Engineering.
A PREDICTION-ERROR ESTIMATION ALGORITHM FOR NONLINEAR OUTPUT-AFFINE SYSTEMS
S. Chen and S. A. Billings Apr. 1987 27 p
(Grant SERC-GR/D/30587)
(RR-314; ETN-88-92061) Avail: NTIS HC A03/MF A01

A prediction-error estimation algorithm for nonlinear discrete-time systems which can be represented by the output-affine difference equation model is developed. The theory of hypothesis testing is employed to select a model with the correct structure. Problems relating to the use of output-affine models in the identification of nonlinear systems are discussed, and a comparison with the nonlinear ARMAX model is given. ESA

N88-21680# Sheffield Univ. (England). Dept. of Control Engineering.
IDENTIFICATION OF NONLINEAR RATIONAL SYSTEMS USING A PREDICTION-ERROR ESTIMATION ALGORITHM
S. A. Billings and S. Chen Aug. 1987 34 p
(Grant SERC-GR/D/30587)
(RR-317; ETN-88-92063) Avail: NTIS HC A03/MF A01

Identification of discrete-time nonlinear stochastic systems which can be represented by a rational input-output model is considered. A prediction-error parameter estimation algorithm is developed and a criterion using results from the theory of hypothesis testing to determine the correct model structure is derived. The identification of a simulated system and a heat exchanger illustrate the algorithms. ESA

N88-21681 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
THE NPL DATA APPROXIMATION SUBROUTINE LIBRARY: CURRENT AND PLANNED FACILITIES
M. G. Cox Nov. 1987 18 p Presented at the NAG Users Association, 10 Sep. 1987
(NPL-DITC-104/87; ISSN-0262-5369; ETN-88-92073) Copyright Avail: National Physics Laboratory, Teddington, Middlesex, TW11 OLW, United Kingdom

The Data Approximation Subroutine Library (DASL) is an integrated FORTRAN library for computing an extensive range of mathematical approximations to discrete data sets and performing various associated tasks. The DASL supplements the facilities for interpolation and curve and surface fitting available in Chapters EO1 and EO2 of the NAG Library. It offers: additional polynomial fitting capabilities, periodic splines, parametric splines, geometrically invariant bivariate splines, polynomial and spline statistics, user-specified models, and the ability to operate with unordered data. All DASL spline routines, for both curves and surfaces, operate with splines of arbitrary order, whereas the NAG Library is concerned specifically with cubic splines. The NAG capability of permitting knots of any multiplicity is retained. The DASL consists of 46 fully-documented user routines and 19 comprehensive sample programs illustrating their use. There are 200 auxiliary (lower-level) routines. ESA

N88-21682*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Engine Business.
AERO/STRUCTURAL TAILORING OF ENGINE BLADES (AERO/STAEBL) Interim Report
K. W. Brown Mar. 1988 60 p
(Contract NAS3-22525)
(NASA-CR-180805; NAS 1.26:180805; PWA-5774-82) Avail: NTIS HC A04/MF A01 CSCL 09B

This report describes the Aero/Structural Tailoring of Engine Blades (AERO/STAEBL) program, which is a computer code used to perform engine fan and compressor blade aero/structural numerical optimizations. These optimizations seek a blade design of minimum operating cost that satisfies realistic blade design constraints. This report documents the overall program (i.e., input, optimization procedures, approximate analyses) and also provides a detailed description of the validation test cases. Author

N88-21683# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
EXAMINATION OF THE EFFECTS OF USING Ada (TRADE NAME) IN FLIGHT CONTROL SOFTWARE M.S. Thesis
John D. Klemens Dec. 1987 76 p
(AD-A189679; AFIT/GCS/MA/87D-3) Avail: NTIS HC A05/MF A01 CSCL 12E

This research characterizes flight control software in terms of the Ada (TM) constructs used and of the performance characteristics that determine the suitability of a particular compiler/processor system for flight control software. A new set of three flight control software benchmarks based on this characterization was evaluated on two MIL-STD-1750A processors using two Ada compliers. Results show that compiler/processor combinations can be compared for their ability to implement flight control software in execution speed and memory size required. The benchmarks provide time and space requirements for a typical sample of flight control software. GRA

N88-21684# Naval Research Lab., Washington, D.C.
A GRAM-SCHMIDT SPACE-TIME ADAPTIVE CANCELLER USING ADAPTIVE LATTICE FILTERS Interim Report
Karl Gerlach and F. F. Kretschmer, Jr. 5 Feb. 1988 15 p
(AD-A189684; NRL-9054) Avail: NTIS HC A03/MF A01 CSCL 17I

A new algorithm is presented for the implementation of an adaptive space-time canceller. This algorithm is a combination of the Gram Schmidt and adaptive lattice filter orthogonalization techniques. The new algorithm is shown to have the potential of using far less hardware or equivalently, less numerical operations than other space-time canceller configurations. GRA

N88-21685# New York Univ., New York.
EVALUATION OF A PARALLEL CHART PARSER
Ralph Grishman and Mahesh Chitrao Sep. 1987 14 p
(Contract N00014-85-K-0163; Grant NSF DCR-85-01843)
(AD-A189172; PROTEUS-M-10) Avail: NTIS HC A03/MF A01

A parallel implementation of a chart parser is described for a shared memory multiprocessor. The speed ups obtained with this parser were measured for a number of small natural language grammars. For the largest of these, part of an operational question answering system, the parser ran 5 to 7 times faster than the serial version. GRA

N88-21686*# VAIR, Inc., Williamsburg, Va.
IMPLEMENTING EMBEDDED ARTIFICIAL INTELLIGENCE RULES WITHIN ALGORITHMIC PROGRAMMING LANGUAGES
Stefan Feyock Mar. 1988 51 p
(Contract NAS1-18002)
(NASA-CR-178393; NAS 1.26:178393) Avail: NTIS HC A04/MF A01 CSCL 09B

Most integrations of artificial intelligence (AI) capabilities with non-AI (usually FORTRAN-based) application programs require the latter to execute separately to run as a subprogram or, at best, as a coroutine, of the AI system. In many cases, this organization is unacceptable; instead, the requirement is for an AI facility that runs in embedded mode; i.e., is called as subprogram by the application program. The design and implementation of a Prolog-based AI capability that can be invoked in embedded mode are described. The significance of this system is twofold: Provision of Prolog-based symbol-manipulation and deduction facilities makes a powerful symbolic reasoning mechanism available to applications

programs written in non-AI languages. The power of the deductive and non-procedural descriptive capabilities of Prolog, which allow the user to describe the problem to be solved, rather than the solution, is to a large extent vitiated by the absence of the standard control structures provided by other languages. Embedding invocations of Prolog rule bases in programs written in non-AI languages makes it possible to put Prolog calls inside DO loops and similar control constructs. The resulting merger of non-AI and AI languages thus results in a symbiotic system in which the advantages of both programming systems are retained, and their deficiencies largely remedied. Author

N88-21687*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARALLEL ALGORITHMS FOR MAPPING PIPELINED AND PARALLEL COMPUTATIONS Final Report
David M. Nicol Apr. 1988 35 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181655; ICASE-88-2; NAS 1.26:181655) Avail: NTIS HC A03/MF A01 CSCL 09B

Many computational problems in image processing, signal processing, and scientific computing are naturally structured for either pipelined or parallel computation. When mapping such problems onto a parallel architecture it is often necessary to aggregate an obvious problem decomposition. Even in this context the general mapping problem is known to be computationally intractable, but recent advances have been made in identifying classes of problems and architectures for which optimal solutions can be found in polynomial time. Among these, the mapping of pipelined or parallel computations onto linear array, shared memory, and host-satellite systems figures prominently. This paper extends that work first by showing how to improve existing serial mapping algorithms. These improvements have significantly lower time and space complexities: in one case a published O(nm sup 3) time algorithm for mapping m modules onto n processors is reduced to an O(nm log m) time complexity, and its space requirements reduced from O(nm sup 2) to O(m). Run time complexity is further reduced with parallel mapping algorithms based on these improvements, which run on the architecture for which they create the mappings. Author

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-21688# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Computer Science.
DISTRIBUTED OPERATING SYSTEMS: AN OVERVIEW
Mehmet Aksit Oct. 1987 26 p
(INF-87-29; ETN-88-91830) Avail: NTIS HC A03/MF A01

Layered systems, operating systems, and distributed computer systems are defined. The differences between parallel and distributed processing are identified. Existing distributed operating systems are listed. Distributed operating system design issues are summarized. ESA

N88-21689# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
PARALLEL PROCESSES IN THE KNOWLEDGE BASED SYSTEM HYDRA
H. J. vandenHerik, J. Henseler, A. G. Hofland, and C. R. J. Verhoest 1987 17 p
(Rept-87-38; B8723341; ISSN-0920-8577; ETN-88-91848)
Copyright Avail: NTIS HC A03/MF A01

Two approaches of parallelism, viz. a centralized-control approach (HYDRA 1) and a decentralized one (HYDRA 2) are described. Due to expected communication overhead in the HYDRA 1 concept, emphasis is put on HYDRA 2. In order to simulate a parallel machine a parallel computer simulator (PCS) was built and a statistics program is used for analyzing the performance of the PCS. The HYDRA 2 implementation is submitted to various experiments from which two conclusions are drawn: adding more rule processors does not guarantee a further speed up; depending on distinct factors an optimal configuration can be specified; and complexity of antecedents in the rules to be used has considerable influence on the optimal configuration, implying that effective use of parallelism is domain dependent, i.e., the number of processors may be restricted by domain knowledge. ESA

N88-21690# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
USING A PARALLEL COMPUTER SYSTEM FOR STATISTICAL RESAMPLING METHODS
Leonard Kaufman, Philip K. Hopke, and Peter J. Rousseeuw 1987 21 p
(Rept-87-47; B8725982; ISSN-0920-8577; ETN-88-91856)
Copyright Avail: NTIS HC A03/MF A01

The advantages of using a parallel computer for the implementation of statistical algorithms that are based on processing a large number of samples taken from the data are reviewed. Typical applications are the clustering of large data sets and the computation of robust regression coefficients. ESA

N88-21691# Groningen Rijksuniversiteit (Netherlands). Dept. of Mathematics and Computing Science.
DEADLOCK-FREE MESSAGE ROUTING IN PROCESSOR NETWORKS
Peter A. J. Hilbers and Johan J. Lukkien 16 Jul. 1987 19 p
(CS-8706; ETN-88-91864) Avail: NTIS HC A03/MF A01

The concept of message routing is formalized, and it is shown that given an arbitrary processor network and a routing algorithm, a deadlock-free routing algorithm can be generated no matter whether cut-through or store-and-forward routing is used. The method is illustrated by constructing deadlock-free routing algorithms for cartesian product processor networks. ESA

N88-21692# Groningen Rijksuniversiteit (Netherlands). Dept. of Mathematics and Computing Science.
ON THE PRODUCTIVITY OF RECURSIVE LIST DEFINITIONS
Ben A. Sijtsma 1987 24 p
(CS-8707; ETN-88-91865) Avail: NTIS HC A03/MF A01

Related notions of productivity for languages with lazy evaluation are presented. The notion of productivity captures the idea of computability, of progress of infinite-list programs. If an infinite-list program is productive then any finite initial part of the list can be computed in finite time. These notions are used to study recursive list definitions, i.e., lists defined as l where l = f l. Sufficient conditions in terms of the function f, that guarantee the computability, productivity of the expression, are given. A calculus that can be used in verifying that the expression above is productive is developed. Nontrivial examples illustrate the power and usefulness of the conditions. ESA

N88-21693# Fondazione Ugo Bordoni, Rome (Italy).
IMPACT OF BLOCKING POLICIES IN CLOSED, EXPONENTIAL AND SYMMETRICAL RING NETWORKS
Davide Grillo and Vittoria deNittoPersone 15 Jul. 1986 39 p
(FUB-8-1986; ETN-88-91872) Avail: NTIS HC A03/MF A01

Three blocking policies for ring networks that are closed, exponential, and symmetrical, are considered: (1) immediate blocking; (2) deferred blocking; (3) unconditional immediate blocking. Policies 1 and 2 apply to nodes where the next leaving job is directed to a saturated neighboring node. According to policy 3, derived from policy 1, as soon as a node becomes saturated, all its upstream neighboring nodes are blocked, independently of their next leaving jobs' destination. It is assumed that all nodes behave according to the same policy and the relative merits of the three policies, as referred to unidirectional and bidirectional ring topologies, are evaluated. For bi-ring networks, policy 1 is best, followed by 2, followed by 3. For single-ring networks, policy 2 is best, and 3 is again worst. Policy 3 may be valid if assumptions underlying symmetry, as related to topology, routing, capacity, and processing rate are relaxed. ESA

N88-21694# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Flugversuchstechnik.
CONCEPTION OF A KNOWLEDGE-BASED SYSTEM FOR DESIGNING DISTRIBUTED SYSTEMS Thesis - Technische Univ., Brunswick, Fed. Republic of Germany
Juergen Friedrichs Aug. 1987 211 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1110)
(DFVLR-Mitt-87-16; ISSN-0176-7739; ETN-88-92115) Avail: NTIS HC A10/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 69 Deutsche marks

A computer-based tool for designing distributed systems is described. Using the Petri-net variation a graphic representation of dynamic, parallel process sequences under fixed time conditions is possible. The Petri-net variation is an independent description method as well. Also found is a separately usable concept for the design of user shells in larger data-processing systems. For the implementation as a knowledge-based system, the elements from knowledge representation (facts, rules) should be reproduced in the form of the Petri-net variation. The Prolog inference mechanism is tranformed into a part of the Petri nets. ESA

N88-21695# Technische Univ., Munich (West Germany). Inst. fuer Informatik.
PASSIVE COUPLER, NETWORK ADAPTER, AND NETWORK ACQUISITION PROCEDURE FOR OPTICAL LOCAL NETWORKS Ph.D. Thesis [PASSIVE KOPPLER, NETZWERKADAPTER, NETZZUGRIFFSVERFAHREN FUER OPTISCHE LOKALE NETZE]
Yeung-Cho Ip 1986 103 p In GERMAN; ENGLISH summary
(ETN-88-92130) Avail: NTIS HC A06/MF A01

The number of stations in a network that can be connected by passive couplers was assessed using a simple loss-model for networks of bus topology. The structure of network interface adapters was investigated. A simple two-level buffer-memory structure is proposed to reduce the complexity of network interfaces for very high transfer rates. Based on this buffer-memory structure and global network parameters, the relation between receive-buffer size and the number of back-to-back packets that can be received is found. A relatively high throughout can be achieved even using small buffers. It is argued that a physical ring is the simplest structure for optical networks. A very simple to implement medium access method for a ring network called the Acknowledgement Buffer Insertion is presented. This method has better worst-case throughout-delay characteristics than the token ring. ESA

N88-21696# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PROPOSAL FOR A PARALLEL SYSTEM WITH IMAGE PROCESSING APPLICATIONS [PROPOSTA DE UM SISTEMA PARALELO COM APLICACOES EM PROCESSAMENTO DE IMAGENS]
Celso Luiz Mendes Aug. 1987 17 p In PORTUGESE Presented at the 1st Brazilian Symposium on Computer Architecture-Parallel Processing, Gramado, Brazil, 13-15 May 1987
(INPE-4293-PRE/1164) Avail: NTIS HC A03/MF A01

A short summary is made of famous parallel machines already developed for digital image processing and is presented as a natural extension. The principle characteristics of the components, which are being studied with modified parallel architecture and operation in the SIMD mode, connected with the instrument already developed for its programming and some examples of basic simulation applications explaining the advantages and disadvantages of its utilization are shown. An architecture is proposed for a system based on this component and connected to an IBM PC-type microcomputer, with possible applications in image processing. Finally, possible future development are suggested which will increase the functionality of the system. Author

N88-21697*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LABORATORY INFORMATION MANAGEMENT SYSTEM (LIMS): A CASE STUDY
Karen S. Crandall, Judith V. Auping, and Robert G. Megargle (Cleveland State Univ., Ohio.) 1987 18 p Presented at the 1st International Laboratory Information Management Systems Meeting, Pittsburgh, Pa., 23-25 Jan. 1987
(NASA-TM-100835; E-4024; NAS 1.15:100835) Avail: NTIS HC A03/MF A01 CSCL 09B

In the late 70's, a refurbishment of the analytical laboratories serving the Materials Division at NASA Lewis Research Center was undertaken. As part of the modernization efforts, a Laboratory Information Management System (LIMS) was to be included. Preliminary studies indicated a custom-designed system as the best choice in order to satisfy all of the requirements. A scaled down version of the original design has been in operation since 1984. The LIMS, a combination of computer hardware, provides the chemical characterization laboratory with an information data base, a report generator, a user interface, and networking capabilities. This paper is an account of the processes involved in designing and implementing that LIMS. Author

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-21698# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
PHOTO-OPTICAL CONVERTER OF ANGULAR DISPLACEMENTS IN DIGITAL SERVOMECHANISMS
A. L. Zhadkevich, G. D. Karlov, and L. E. Kulikova 1986 7 p In RUSSIAN
(DE87-703208; IFVE-OEA-86-181) Avail: NTIS (US Sales Only) HC A02/MF A01

Peculiarities of the design and electronic circuits of a photo-optical transducer converting the rotation angle of the shaft to pulse repetition are described. The unit of converter counting with quadrupling output pulses makes up 5 ft. 24 in., the limiting frequency is 150 kHz. Output data are transmitted stably over current circuit at the distance up to 250 m. The converter is designed for utilization in high-current servosystems with digital control. DOE

N88-21699# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/Dept. of Interactive Systems.
REPRESENTING KNOWLEDGE IN TWO DISTINCT DESCRIPTIONS: EXTENSIONAL VS. INTENSIONAL
Tetsuo Tomiyama and Paul J. W. tenHagen Jun. 1987 22 p Submitted for publication
(CWI-CS-R8728; B8723976; ETN-88-91773) Copyright Avail: NTIS HC A03/MF A01

A data description method for Computer Aided Design (CAD) is proposed. To describe entities and their abstract concepts (such as attributes and relationships among entities), there are two possible ways, i.e., an extensional description with abstract concepts as topology of the entity concept set, and an intensional description with an entity concept set as topology of the abstract concept set. Although the two description methods are almost identical, an extensional description method provides a holistic view, whereas in an intensional description method entities are constructed from predetermined abstract concepts. Extensional data descriptions are more suitable for CAD systems, because difficult data operations (e.g., modifications) can be done by easy (hence cheap) operations. However, conventional CAD systems are usually implemented based on intensional data descriptions. This is primarily due to good performance for simple data operations. Therefore, a data description method which integrates

extensional and intensional views and which satisfies requirements for future CAD systems is needed. The solution is to have two separated worlds, the object world representing entities and the predicate world representing abstract concepts, and functions between them. ESA

N88-21700# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A NEW APPROACH TO ALMOST DECOUPLING PROBLEMS FOR LINEAR AND NONLINEAR SYSTEMS
R. Marino, W. Respondek (Polish Academy of Sciences, Warsaw.), and A. J. vanderSchaft Sep. 1987 19 p Submitted for publication
(MEMO-660; B8729563; ISSN-0921-1969; ETN-88-91834) Avail: NTIS HC A03/MF A01

An approach to high-gain feedback design for linear and nonlinear systems based on singular perturbation analysis and geometric systems theory is reviewed. This results in the linear case in the solution of the almost input-output decoupling problem, together with a solution of the almost disturbance decoupling problem. The procedure followed for both problems yields an explicit state feedback scheme parameterized by a small positive scalar and is based, geometrically speaking, on the structure at infinity of the system. In the nonlinear case the same approach is used to solve the almost disturbance decoupling problem for single-input - single-output systems. An interesting question is if the nonlinear results obtained also can lead to a nonlinear generalization of the geometric concept of almost controlled invariant subspaces. ESA

N88-21701# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A POLYNOMIAL APPROACH TO THE H SUB INFINITY CONTROL DESIGN METHOD
Piet Boekhoudt and Huibert Kwakernaak Oct. 1987 19 p
(MEMO-662; B8729565; ISSN-0921-1969; ETN-88-91836) Avail: NTIS HC A03/MF A01

It is shown that the standard H sub infinity control optimization problem of Francis and Doyle (1987) may be reduced to a homotopy problem defined by a set of matrix polynomial equations. The approach avoids the pole cancellation problem inherent in the conventional reduction to Nehari form. The homotopy may be solved numerically by transformation to a differential equation. An example illustrates the method. ESA

N88-21702# Oxford Univ. (England). Dept. of Engineering Science.
A STATE-SPACE APPROACH TO SUPER-OPTIMAL H SUP INFINITY CONTROL PROBLEMS
M. C. Tsai, D.-W. Gu, and I. Postlethwaite 1987 41 p
(OUEL-1690/87; ETN-88-92034) Avail: NTIS HC A03/MF A01

A numerically stable algorithm for solving the strengthened (or super-optimal) model-matching problem is presented. The steps of the algorithm follow closely those given in Young (1986) except that for each step a reliable implementation using state-space models is provided. ESA

N88-21703# Oxford Univ. (England). Dept. of Engineering Science.
A COMPLEXITY TRANSFORM FOR NP-COMPLETE PROBLEMS
G. M. Megson 1987 26 p
(OUEL-1708/87; ETN-88-92038) Avail: NTIS HC A03/MF A01

It is demonstrated that the problem of determining whether a Boolean function E with n-variables is satisfiable can be reduced to the problem of determining the stability of a feedback control system. If Q(n) is the worst case deterministic polynomial time required to check E for a particular assignment of the n variables the stability of the control problem can be evaluated in at most O(Q(n) to the 10th power) deterministic steps. It is concluded that for every E there exists a deterministic polynomial time algorithm for deciding satisfiability. This implies that P equals NP. ESA

N88-21704# Sheffield Univ. (England). Dept. of Control Engineering.
BILINEAR SYSTEMS IN THE FREQUENCY DOMAIN AND AN APPLICATION TO OPTIMAL CONTROL
S. P. Banks and N. Iddir 1987 17 p
(RR-320; ETN-88-92066) Avail: NTIS HC A03/MF A01

A frequency domain approach to the optimal control of bilinear systems, based on a representation of the input-output map of the system in terms of a basis of L sq (O, T), is presented. The method is a direct generalization of the linear frequency domain approach, since it is based on an isomorphism between the time and frequency domains. It is shown that, taking a finite number of basis vectors, the solution of the optimal control problem is given in terms of a set of polynomial equations. ESA

N88-21705# Oxford Univ. (England). Dept. of Engineering Science.
SYSTOLIC DETERMINATION OF ABSOLUTE STABILITY IN FEEDBACK CONTROL SYSTEMS
G. M. Megson 1987 22 p
(OUEL-1704/87) Avail: NTIS HC A03/MF A01

Systolic arrays for the construction of the Routh-Hurwitz and Jury-Marden stability criteria in continuous and discrete time feedback control systems are considered. Arrays with two-way, unidirectional, and multipass data flow are derived using topological and isomorphic transformations of the space-time representations of algorithms based on their data dependencies. The arrays compute in O(3n) time for a table of size O(n) rather than the O(n sq) required in the sequential algorithm. The technique can also be used for indicating the root distribution of general polynomials with real coefficients, and the speed up over sequential table construction used to locate values of gain where a system becomes unstable. Author

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-21706# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
A GRAPH SEPARATOR THEOREM AND ITS APPLICATION TO GAUSSIAN ELIMINATION TO OPTIMIZE BOOLEAN EXPRESSIONS FOR PARALLEL EVALUATION Interim Report
Thomas J. Sheffler Dec. 1987 87 p
(Contract F33615-84-K-1520)
(AD-A188527; CMU-CS-87-123; AFWAL-TR-87-1159) Avail: NTIS HC A05/MF A01 CSCL 20C

Gaussian elimination, which has been shown to be applicable to the solution problems in many different domains, is the technique used by COSMOS to symbolically analyze digital MOS networks for their behavior in terms of Boolean expressions. While pivot selection algorithms are known which minimize the total number of operations required to solve a system, this report will focus on pivot selection algorithms that result in expressions of small depth, from which fine-grained parallelism may be extracted. A graph theoretic approach to Gaussian elimination is adopted which allows the structure of sparse systems to be clearly examined, and an elimination ordering based on graph separators is shown to result in expressions of small depth. This report proposes an algorithm related to Gaussian elimination which characterizes graphs in terms of decomposition rules and shows that for graphs which may be reduced by an elimination ordering the results in low total complexity, a reordered elimination sequence may result in expressions of small depth. GRA

N88-21707# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
EFFICIENT MONOTONE SEQUENTIAL DESIGN

Thomas A. Louis (Harvard School of Public Health, Boston, Mass.) Apr. 1987 30 p
(Grants ESO-2709; NSF INT-85-12148)
(CWI-MS-R8705; B8723352; ETN-88-91793) Copyright Avail: NTIS HC A03/MF A01

A class of monotone designs based on a scale invariant design objective, and two structures for statistical information is considered. One factors into a function of time and a function of the unknown parameter and results from data from a scale family for each t. The other depends on time divided by the unknown parameter, and results, for example, from destructive life tests. Two and three-stage adaptive rules are investigated, and the asymptotic order of the regret for these rules relative to the rule taking all data at the optimal time is computed. It is shown that the order is close to the best possible. The rate at which the performance of these rules departs from scale invariance is found. A simulation study comparing the current rule to others is summarized. ESA

N88-21708# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ON A BOUND OF THE MODELING ERRORS OF BLACK-BOX TRANSFER FUNCTION ESTIMATES
Yu-Cai Zhu (Xian Jiaotong Univ., China) May 1987 30 p
(EUT-87-E-173; ISBN-9-06-144173-0; ISSN-0167-9708; ETN-88-91820) Avail: NTIS HC A03/MF A01

The problem of estimating the upper bound of modeling errors of transfer function estimates is considered, particularly for designing robust control systems, where a bound of uncertainty of the transfer function estimate is necessary. The results of Ljung and Yuan's (1985) asymptotic theory on the properties of black-box transfer function estimates when time domain estimation techniques are used, are extended to the case where spectral analysis is used. It is shown that the transfer function estimate, obtained either by the prediction error method or by spectral analysis, is consistent; the error of the transfer function estimate is asymptotically normal and the asymptotic variance of the error at a certain frequency is given by the noise-to-signal ratio at that frequency multiplied by the model-order-to-number-of-data-points ratio. Based on this theory, a bound of modeling error is defined as the sum of the absolute value of the bias part of the error and the 3 sigma bound of the random part of the error. Numerical tests validate the theory. ESA

N88-21709# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
TECHNOLOGY MAPPING FROM BOOLEAN EXPRESSIONS TO STANDARD CELLS M.S. Thesis
M. R. C. M. Berkelaar and J. F. M. Theeuwen Jun. 1987 56 p
(EUT-87-E-174; ISBN-9-06-144174-9; ISSN-0167-9708; ETN-88-91821) Avail: NTIS HC A04/MF A01

An approach to the problem of making a standard cells IC implementation from a previously optimized and decomposed set of boolean functions is presented. The library of standard cells should contain and-or-invert-gates up to a certain maximum size. Libraries of standard cells for NMOS or CMOS technologies usually do. This maximum size is a parameter to the algorithms, so the program can be used for different libraries of standard cells. The total problem is split into two subproblems which are treated separately. First, functions which do not fit into standard gates directly, are split up in pieces small enough to fit. Second, the inverters, which are necessary between the gates in a technology with and-or-invert-gates, are removed if possible. Both problems are attacked in a partly heuristical and partly analytical way. The heuristical part limits the problem to a size small enough for an anlytical approach, which then solves the limited problem completely optimally. Trial runs with benchmark examples show good results. ESA

N88-21710# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
THE CLIQUE POLYTOPE OF A GRAPH
Ulrich Faigle Oct. 1987 12 p
(MEMO-663; B8729566; ISSN-0921-1969; ETN-88-91837) Avail: NTIS HC A03/MF A01

The polytope P generated by the edge incidence vectors of all nontrivial cliques of a complete graph is investigated. The dimensions of the subpolytopes defined by the cliques of a given size are computed. Several classes of facet defining inequalities for P are derived and it is shown that P has diameter one. The Hirsch conjecture is seen to hold for P. ESA

N88-21711# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
AN EXTENSION OF THE MS PIVOTING RULE TO CAPACITATED NETWORK FLOW PROBLEMS
C. Roos and M. Tegze (Karlova Univ., Prague, Czechoslovakia) 1987 24 p
(Rept-87-33; B8721709; ISSN-0920-8577; ETN-88-91844)
Copyright Avail: NTIS HC A03/MF A01

A pivoting rule called maximal slope (MS) rule for the dual simplex method which exploits the tree structure of the basis in the case of network flow problems, is extended to the capacitated network flow problem, i.e., to networks with (lower and) upper capacity bounds on the arcs. It turns out that the coefficients appearing in the MS rule become more complicated in the capacitated case and that they cannot be calculated with the same simplicity as in the uncapacitated case. The possibility to approximate these coefficients maintaining thus both the relatively small number of iterations and fast calculation in each pivot step is discussed. Computational experiments with several variants of the resulting pivoting rule are reported. ESA

N88-21712# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A SPLINE COLLOCATION METHOD FOR INTEGRAL EQUATIONS OF THE FIRST KIND WITH LOGARITHMIC SINGULARITY
E. A. Guseinov and A. J. Hermans 1987 16 p
(Rept-87-39; B8723401; ISSN-0920-8577; ETN-88-91849)
Copyright Avail: NTIS HC A03/MF A01

A numerical (spline collocation) method for solving integral equations of the first kind with weak singularity is presented. The solution of the integral equation is approximated by means of piecewise polynomials; in particular B-splines of second and third order are chosen as a basis. Using a basis function like the B-spline allows analytical calculation of the singular integral. Hence, the element matrix of the system of the linear equations is obtained analytically. ESA

N88-21713# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
ON A CLASS OF SIMILARITY SOLUTIONS OF THE EQUATION u SUB t = (ABSOLUTE VALUE OF u SUP m-1 u SUB x) SUB x WITH m GREATER THAN -1
C. J. vanDuijn, S. M. Gomes, and Zhang Hongfei 1987 26 p
(Rept-87-54; B8731212; ISSN-0920-8577; ETN-88-91860) Avail: NTIS HC A03/MF A01

An initial value problem found in cases such as diffusion in a porous medium is considered, using ordinary differential equation methods. Existence and uniqueness are analyzed. Behavior as f tends to zero, and the limit for decreasing towards -1 are discussed. ESA

N88-21714# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
GENERALIZATIONS OF LAGUERRE (TYPE) POLYNOMIALS
R. Koekoek 1987 38 p
(Rept-87-58; B8731214; ISSN-0920-8577; ETN-88-91862)
Copyright Avail: NTIS HC A03/MF A01

Polynomials which are orthogonal with respect to an inner product are computed. ESA

N88-21715 Technische Univ., Hanover (West Germany). Inst. fuer Angewandte Mathematik.
SOME MAXIMUM NORM ESTIMATES FOR THE FINITE ELEMENT METHOD APPLIED TO NONLINEAR TWO DIMENSIONAL BOUNDARY VALUE PROBLEMS [EINIGE MAXIMUMNORMABSCHAETZUNGEN FUER DIE METHODE DER FINITEN ELEMENTE BEI NICHTLINEAREN EBENEN RANDWERTPROBLEMEN]
Robert Kosler 1987 19 p In GERMAN; ENGLISH summary
(ETN-88-91505) Avail: Universitaet Hannover, Welfengarten 1, D-3000 Hannover 1, Fed. Republic of Germany

The maximim norm convergence of nonlinear two-dimensional boundary value problems of second order was investigated. The problems considered are elliptic but not necessarily strongly elliptic. The strongly monotonic operator equations, the strongly elliptic differential equations, and the finite element spaces are presented. A maximum norm convergence of the order of at least n to the power of (1-epsilon) is demonstrated, where epsilon is an arbitrary element in (0,1), assuming W super 2,2 - regularity for the solution. ESA

N88-21716# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
PROCEDURES FOR UPDATING DYNAMIC MATHEMATICAL MODELS Final Report
B. Caesar, H. Baier, H. Badenhausen, M. Link, H. Hueners (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, West Germany), and H. Erben Paris, France ESA May 1985 280 p
(Contract ESTEC-5597/83-NL-PB(SC))
(EMSB-23/86; ESA-CR(P)-2498; ETN-88-91953) Avail: NTIS HC A13/MF A01

Methods for updating dynamic models were investigated and mathematically formulated: least squares/sensitivity; Natke's iterative method solving the nonlinear system equations; Berman's direct updating of the system matrices; Chen/Garba's iterative method solving the linearized system equations and reducing computational effort with matrix perturbation; direct identification methods in the time domain; and direct identification methods in the frequency domain. Computer program development and application to small test examples are described. ESA

N88-21717*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPLITTING OF INVISCID FLUXES FOR REAL GASES
Meng-Sing Liou, Bram vanLeer, and Jian-Shun Shuen (Sverdrup Technology, Inc., Cleveland, Ohio.) Apr. 1988 31 p
(NASA-TM-100856; ICOMP-88-7; E-4059; NAS 1.15:100856)
Avail: NTIS HC A03/MF A01 CSCL 12A

Flux-vector and flux-difference splittings for the inviscid terms of the compressible flow equations are derived under the assumption of a general equation of state for a real gas in equilibrium. No necessary assumptions, approximations or auxiliary quantities are introduced. The formulas derived include several particular cases known for ideal gases and readily apply to curvilinear coordinates. Applications of the formulas in a TVD algorithm to one-dimensional shock-tube and nozzle problems show their quality and robustness. Author

N88-21718*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHOICE OF IMPLICIT AND EXPLICIT OPERATORS FOR THE UPWIND DIFFERENCING METHOD
Meng-Sing Liou and Bram vanLeer 1988 27 p Presented at the 26th Aerospace Sciences Meeting, Reno, Nev., 11-14 Jan. 1988; sponsored by AIAA
(NASA-TM-100857; ICOMP-88-8; E-4061; NAS 1.15:100857)
Avail: NTIS HC A03/MF A01 CSCL 12A

The flux-vector and flux-difference splittings of Steger-Warming, van Leer and Roe are tested in all possible combinations on the implicit and explicit operators that can be distinguished in implicit relaxation methods for the steady Euler and Navier-Stokes equations. The tests include one-dimensional inviscid nozzle flow, and two-dimensional inviscid and viscous shock reflection. Roe's splitting, as anticipated, is found to uniformly yield the most accurate results. On the other hand, an approximate Roe splitting of the implicit operator (the complete Roe splitting is too complicated for practical use) proves to be the least robust with regard to convergence to the steady state. In this respect, the Steger-Warming splitting is the most robust; it leads to convergence when combined with any of the splittings in the explicit operator, although not necessarily in the most efficient way. Author

N88-21719# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
A NOTE ON THE ANALYTICITY OF THE NEUMANN KERNEL AND AN ASSOCIATED QUADRATURE PROBLEM IN TWO-DIMENSIONAL BOUNDARY ELEMENT METHODS
D. M. Hough Sep. 1987 13 p
(ETN-88-92054) Avail: NTIS HC A03/MF A01

Numerical estimation of an integral incorporating the parametric Neumann kernel, defined using a polynomial of low degree, is considered. The integral arises in boundary element collocation methods for the numerical solution of integral equations in two-dimensional potential theory. It is shown that in applications of the boundary element method to two-dimensional potential theory there is little loss of generality in assuming that each element on the boundary of the solution domain is an analytic arc. It is proved that in this case the associated parametric Neumann kernel is a real analytic function of its arguments. The practical consequence of this is that standard quadrature methods may be used to estimate all boundary integrals arising in the numerical solution of boundary integral equations with the Neumann kernel, as illustrated for the case of low order Gauss-Legendre roles. ESA

N88-21720# Sheffield Univ. (England). Dept. of Control Engineering.
BOUNDARY STABILIZATION OF THE REACTION-DIFFUSION EQUATION WITH UNILATERAL CONDITIONS
S. P. Banks May 1987 11 p
(RR-315; ETN-88-92062) Avail: NTIS HC A03/MF A01

It is shown that, although the introduction of unilateral conditions into a system of parabolic equations can be destabilizing, such systems can be stabilized by the proper use of boundary control. A control which is orthogonal on the boundary to the eigenvalues which have negative real parts can be chosen, so that only the eigenvalues with positive real parts are affected. Although the main result is only proved for a single simple eigenvalue with positive real part, the theory can be extended to systems with a finite number of such eigenvalues. ESA

N88-21721# Sheffield Univ. (England). Dept. of Control Engineering.
APPLICATION OF THE NARMAX METHOD TO NONLINEAR FREQUENCY RESPONSE ESTIMATION
S. A. Billings, K. M. Tsang, and G. R. Tomlinson (Heriot-Watt Univ., Edinburgh, Scotland) Oct. 1987 7 p
(Grant SERC-GR/D/75809)
(RR-319; ETN-88-92065) Avail: NTIS HC A02/MF A01

The NARMAX method of identifying the frequency domain characteristics of nonlinear systems is illustrated by computing the first, second, and third order generalized frequency response functions of a heat exchanger. It is shown that the method can provide estimates of the generalized frequency response functions of any order. ESA

N88-21722# Illinois Univ., Urbana. Coordinated Science Lab.
GRAPH LABELINGS Ph.D. Thesis
Margaret L. Weaver 12 Jan. 1988 97 p
(Contract N00014-85-K-0570)
(AD-A189649; UILU-ENG-88-2203; UILU-ACT-87) Avail: NTIS HC A05/MF A01 CSCL 12B

Given an ordering of the vertices of a graph around a circle, a page is a collection of edges forming non-crossing chords. A book embedding is a circular permutation of the vertices together with a partition of the edges into pages. The pagenumber t (G) is the

minimum number of pages in a book embedding of G. We present a general construction showing t (k sub m,n) or (m + less than 2n)/4), which we conjecture to be optimal. We prove a result suggesting this is optimal for m greater than or equal to 2n - 3. For the most difficult case, m = n, we consider vertex permutations that are regular, i.e., place the vertices from each partite set into runs of equal size. Book embeddings with such orderings require (7n - 2)/9) pages, which is achievable. The general construction uses fewer pages, but with an irregular ordering. GRA

N88-21723# Illinois Univ., Urbana. Coordinated Science Lab.
COMPACT REPRESENTATION OF THE SEPARATING k-SETS OF A GRAPH
Arkady Kanevsky Jan. 1988 31 p
(Contract N00014-84-C-0149; Grant NSF ECS-84-04866)
(AD-A189650; UILU-ENG-88-2204; UILU-ACT-88) Avail: NTIS HC A03/MF A01 CSCL 12B

We present an O(n) space representation for the separating k-sets of an undirected k-connected graph G for fixed k, where n is the cardinality of the vertex set of G. Namely, the total space used by the representation is O(k-squared times n). We also improve the upper bound on the number of separating k-sets of G to O(2 to the kth times(n-squared over k), which has a matching lower bound. GRA

N88-21724# Johns Hopkins Univ., Laurel, Md. Applied Physics Lab.
ADVANCED PACKAGING FOR VLSI/VHSIC (VERY LARGE SCALE INTEGRATED CIRCUITS/VERY HIGH SPEED INTEGRATED CIRCUITS) APPLICATIONS: ELECTRICAL, THERMAL AND MECHANICAL CONSIDERATIONS, AN IR AND D REPORT
G. V. Clatterbaugh and H. K. Charles, Jr Nov. 1987 94 p
(Contract N00039-87-C-5301)
(AD-A189666; JPL/APL-TG-1362) Avail: NTIS HC A05/MF A01 CSCL 09A

A comprehensive study of advanced packaging methods for VLSI and VHSIC applications has been performed. Particular emphasis has been placed on the analytical tools necessary for the modeling and performance simulation (electrical, thermal and mechanical) of complex high performance microelectronic packaging structures. The models have been validated by extensive experimental testing. Packaging and board level performance has been evaluated for various digital logical families including; TTL, ECL and HCMOS. Design guidelines have been developed that can be used by circuit engineers to extract the maximum performance from the devices on various board techniques including multilayer ceramic and organic printed wiring boards. Both surface mounting and through hole mounting have been considered, including methods for designing optimum soldered interconnects for each operational scenario. GRA

N88-21339# Joint Publications Research Service, Arlington, Va.
FINITE ELEMENT EXPLICIT ALGORITHM FOR SOLVING TEMPORAL TEMPERATURE FIELDS Abstract Only
Zhenzhong Huang *In its* JPRS Report: Science and Technology. China 2 Dec. 1987 p 1 Transl. into ENGLISH from Yingyong Shuxue He Lixue (Chongqing, Peoples Republic of China), v. 8, no. 6, Jun. 1987 p 497-504 (For primary document see N88-21338 14-31)
Avail: NTIS HC A06/MF A01

N88-21352# Joint Publications Research Service, Arlington, Va.
WEIGHTED AVERAGING METHOD FOR IMAGE SMOOTHING REPORTED
Demin Wang and Qinglin Wang *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 6-11 Transl. into ENGLISH from Dianzi Xuebao (Beijing, Peoples Republic of China), v. 14, no. 6, Nov. 1986 p 85-90 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-21725# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
ADMISSIBILITY IN FAIR BAYES PREDICTION PROBLEMS. PART 1: GENERAL THEORY
Morris L. Eaton (Minnesota Univ., Minneapolis.) Apr. 1987 40 p
(Grant NSF DMS-83-19924)
(CWI-MS-R8703; B8723350; ETN-88-91792) Copyright Avail: NTIS HC A03/MF A01

Sufficient conditions for the admissibility of posterior predictive distributions which are derived from improper proper distributions are considered. It is argued that the relevant loss functions are the so called fair Bayes loss functions. The admissibility results are valid for a wide class of such loss functions. The main result is applied to the one dimensional translation problem with Lebesgue measure as the improper prior to give sufficient conditions for admissibility of the resulting predictive distribution. A connection with recurrence of an induced Markov chain is described. ESA

N88-21726# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
CONCENTRATION INEQUALITIES FOR GAUSS MARKOV ESTIMATORS
Morris L. Eaton (Minnesota Univ., Minneapolis.) Apr. 1987 36 p
(Grant NSF DMS-83-19924)
(CWI-MS-R8706; B8723353; ETN-88-91794) Copyright Avail: NTIS HC A03/MF A01

Conditions under which the distribution of the Gauss-Markov estimator is more concentrated about the unknown mean vector than the distribution of any other linear unbiased estimator, are given. Let M be the regression subspace and Upsilon the set of possible covariances for a random vector Y. The linear model determined by M and Upsilon is regular if the identity is in Upsilon and if Sigma (M) is contained in M for all Sigma is a member of Upsilon. For such models, concentration inequalities are given for the Gauss-Markov estimator of the mean vector under various distributional and invariance assumptions on the error vector. Invariance is used to establish monotonicity results relative to a natural group induced partial ordering. ESA

N88-21727# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
PRODUCT-INTEGRALS AND COUNTING PROCESSES
Richard D. Gill and Soren Johansen (Copenhagen Univ., Denmark) Jul. 1987 39 p
(CWI-MS-R8707; B8731187; ETN-88-91795) Copyright Avail: NTIS HC A03/MF A01

The basic theory of the product-integral Pi (1+dX) is summarized and applications in probability and statistics, in particular to nonhomogeneous Markov processes, counting process likelihoods, and the product-limit estimator, are discussed. ESA

N88-21728# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
ON THE EDGEWORTH EXPANSION AND THE BOOTSTRAP APPROXIMATION FOR A STUDENTIZED U-STATISTIC
R. Helmers Jul. 1987 18 p
(CWI-MS-R8708; B8731188; ETN-88-91797) Copyright Avail: NTIS HC A03/MF A01

The asymptotic accuracy of the estimated one-term Edgeworth expansion and the bootstrap approximation for a Studentized U-statistic is investigated. It is shown that the Edgeworth expansion estimate and the bootstrap approximation are asymptotically closer to the exact distribution of a Studentized U-statistic than the normal approximation. The conditions needed to obtain these results are weak moment assumptions on the kernel h of the U-statistic and a nonlattice condition of the distribution of g(x1) = E(h(X1,X2)/X1). Improved Edgeworth and bootstrap based confidence intervals for

the mean of a U-statistic are obtained. Extensions to Studentized statistical functions admitting a second order von Mises expansion, such as Studentized L-statistics with smooth weights and Studentized M-estimators of maximum likelihood type, are discussed. ESA

N88-21729# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
ON A CONSISTENT ESTIMATE OF THE INDEX OF AN EXTREME VALUE DISTRIBUTION
Arnold L. M. Dekkers and Laurens deHaan (Erasmus Univ., Rotterdam, Netherlands) Sep. 1987 20 p
(CWI-MS-R8710; B8731190; ETN-88-91799) Copyright Avail: NTIS HC A03/MF A01

An easy proof for the weak consistency of Pickand's estimate of the main parameter of an extreme-value distribution is derived. Natural conditions for strong consistency and for asymptotic normality of the estimate are given. ESA

N88-21730# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
LARGE QUANTILE ESTIMATION UNDER EXTREME-VALUE CONDITIONS
Arnold L. M. Dekkers and Laurens deHaan (Erasmus Univ., Rotterdam, Netherlands) Sep. 1987 17 p
(CWI-MS-R8711; B8731191; ETN-88-91800) Copyright Avail: NTIS HC A03/MF A01

Flood prediction is considered. The safety standard for dike construction states that the probability that at any time in a given year the sea-level exceeds the level of the dikes is 1:10,000. The question of how to give an estimate for such a level from past observations involves estimation of large quantiles of an unknown distribution function. A large quantile is estimated by a combination of extreme or intermediate order statistics. This leads to an asymptotic confidence interval. ESA

N88-21731# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A ROBUST SCALE ESTIMATOR BASED ON THE SHORTEST HALF
P. Rousseeuw and A. Leroy 1987 22 p
(Rept-87-36; B8721711; ISSN-0920-8577; ETN-88-91846)
Copyright Avail: NTIS HC A03/MF A01

A robust estimator of scale which is proportional to the length of the shortest half of the sample is considered. The estimator is compared to the interquartile range and the median absolute deviation, that are also based on order statistics. All three estimators have the same influence function, but their breakdown points differ. It turns out that a finite-sample correction factor which depends on mod(n,4) is needed to achieve approximate unbiasedness. ESA

N88-21732# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
DETERMINISTIC APPROXIMATIONS OF PROBABILITY INEQUALITIES
Janos Pinter 1987 44 p
(Rept-87-43; B8723680; ISSN-0920-8577; ETN-88-91852)
Copyright Avail: NTIS HC A03/MF A01

A simple general framework for deriving deterministic approximations of probability inequalities of the form P (xi is greater than or = a) is less than or = a is presented. The approximations are based on limited parametric information about the involved random variable(s) (such as their mean, variance, range or upper bound values). The case of a single random variable xi is analyzed, followed by the cases of independent and dependent summands xi = Sigma (n,1) xi i. As examples of possible applications, stochastic extensions of the knapsack problem and of the stochastic linear programming problem with separate chance-constraints are investigated. Approximate deterministic surrogates for these problems are given. ESA

N88-21733# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
HYPERBOLICITY AND INVARIANT MEASURES FOR GENERAL C SQ INTERVAL MAPS SATISFYING THE MISIUREWICZ CONDITION
S. vanStrien 1987 59 p
(Rept-87-46; B8725981; ISSN-0920-8577; ETN-88-91855)
Copyright Avail: NTIS HC A04/MF A01

It is shown that C sq mapping on (0,1) or S sup 1 satisfying the socalled Misiurewicz conditions are globally expanding and have absolute continuous invariant measures of positive entropy. No assumptions on the Schwarzian derivative of these maps are needed, but all critical points of f are non-flat, and f has no periodic attractors. The proof gives an algorithm to verify this last condition. The result implies the result of Misiurewicz (1981) where only maps with negative Schwarzian derivatives are considered. The approach implies (and simplifies the proof of) the results of Mane (1985) for general C sq maps (without conditions on the Schwarzian derivative), and restricts attention to points whose forward orbits stay away from the critical points. A complication that in the presented case is that points whose iterations come arbitrarily close to critical points are not considered. In order to deal with this nonlinearity the tools of de Melo and van Stiern are used. The obtained estimates are so precise that invariant measures can be proved in a very simple way. ESA

N88-21734# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
MIXING PROPERTIES FOR RANDOM WALK IN RANDOM SCENERY
W. Th. F. denHollander 1987 24 p
(Rept-87-48; B8731207; ISSN-0920-8577; ETN-88-91857)
Copyright Avail: NTIS HC A03/MF A01

The lattice 2 sup d, d greater than or = 1 and a stochastic black-white coloring of its points and on it a random walk that is independent of the coloring are considered. A local scenery perceived at a given time is a pattern of colors seen by the walker in a finite box around his current position. Under a general set of assumptions on the probability distributions governing walk and coloring, asymptotic independence of local sceneries perceived at times 0 and Tk in the limit as k tends to infinity where Tk is the random k-th hitting time of a black point is proved. An immediate corollary of this result is the convergence in distribution of the interarrival times between successive black hits, i.e., of T(k+1)-Tk as k tends to infinity. The limit distribution is expressed in terms of the distribution of the first hitting time T1. The proof uses coupling arguments and ergodic theory. ESA

N88-21735# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
ABSOLUTELY CONTINUOUS INVARIANT MEASURES FOR C SQ UNIMODAL MAPS SATISFYING THE COLLET-ECKMANN CONDITIONS
T. Nowicki and S. vanStrien 1987 27 p
(Rept-87-55; B8731213; ISSN-0920-8577; ETN-88-91861)
Copyright Avail: NTIS HC A03/MF A01

It is shown that unimodal mappings f: (0,1) to (0,1) have absolutely continuous measures of positive entropy if these maps are C sq and satisfy the so-called Collet-Eckmann conditions. No conditions on the Schwarzian derivative of f are assumed. ESA

N88-21736# Sheffield Univ. (England). Dept. of Control Engineering.
AN ORTHOGONAL PARAMETER ESTIMATION ALGORITHM FOR NONLINEAR STOCHASTIC SYSTEMS
M. Korenberg (Queens Univ., Kingston, Ontario), S. A. Billings, and Y. P. Liu Mar. 1987 30 p
(RR-307; ETN-88-92059) Avail: NTIS HC A03/MF A01

An orthogonal parameter estimation algorithm which allows each parameter in a nonlinear difference equation model to be estimated recursively and independently of the other parameters in the model is derived. The algorithm can be applied for any persistently exciting input and provides unbiased estimates in the presence of correlated

noise and an indication of which terms to include in the model. Simulated examples demonstrate the effectiveness of the algorithm. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-21737# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
EXACT ANALYSES OF SLOTTED RING PROTOCOLS FOR LOCAL AREA NETWORKS WITH ONE TRANSMITTING STATION
B. vanArem and E. A. vanDoorn Aug. 1987 20 p
(MEMO-650; B8727234; ISSN-0921-1969; ETN-88-91833) Avail: NTIS HC A03/MF A01

Slotted ring protocols for local area networks where packets of equal and fixed size containing digital information arrive at a station which is connected to a slotted ring are considered. The arrival process of these packets is a compound Poisson process: batches of packets arrive according to a Poisson process. Batch sizes are independent and identically distributed random variables. At the station the packets queue and wait for transmission. On the ring s slots circulate with fixed speed. Each slot can accommodate exactly one packet. Slots are filled at the transmission station and may be emptied elsewhere depending on the protocol which is used. For six protocols, exact results for the queue length at the transmitting station are given. The results as such are not very useful, for a slotted ring protocol with one transmitting station is certainly not very realistic, but the main goal is to provide a basis for the development of approximations in the case of several transmitting stations. ESA

N88-21738# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
PERFECT KNOWLEDGE AND BEYOND
S. T. Dekker, H. J. vandenHerik, and I. S. Herschberg 1987 17 p
(Contract ZWO-39-SC-68-129)
(Rept-87-37; B8723679; ISSN-0920-8577; ETN-88-91847)
Copyright Avail: NTIS HC A03/MF A01

Data bases of chess endgames are reviewed. Research is reaching the stage where perfect knowledge allows one to grasp simple endgames which, in most instances, show pathologies never thought of by grand-masters' intuition. For some endgames, the maximum exceeds Fide's 50-move rule, thus precipitating a discussion about altering the rule. However, even though it is now possible to determine exactly the path lengths of many 5-men endgames (or of fewer men), it is felt there is an essential flaw if each endgame should have its own limit to the number of moves. The consequences of a k-move rule which, whatever the value of k, may change a naive optimal strategy into a k-optimal strategy which may well be radically different, are discussed. ESA

N88-21739# General Accounting Office, Washington, D. C. National Security and International Affairs Div.
STRATEGIC DEFENSE INITIATIVE PROGRAM: STATUS OF SPACE SURVEILLANCE AND TRACKING SYSTEM
Nov. 1987 9 p
(PB88-150438; GAO/NSIAD-88-61) Avail: NTIS HC A02/MF A01 CSCL 12B

The Strategic Defense Initiative (SDI) is the Department of Defense's program to determine the feasibility of developing and deploying a defense against nuclear ballistic missiles. The program envisions a layered defense system capable of destroying a nuclear ballistic missile during any of its four phases of light-boost, post-boost, midcourse, or terminal. Information is contained on the status of the Strategic Defense Initiative Organization's (SDIOs) research on the Space Surveillance and Tracking System (SSTS). GRA

N88-21740*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
USER'S MANUAL FOR LINEAR, A FORTRAN PROGRAM TO DERIVE LINEAR AIRCRAFT MODELS
Eugene L. Duke, Brian P. Patterson, and Robert F. Antoniewicz Dec. 1987 109 p
(NASA-TP-2768; H-1259; NAS 1.60:2768) Avail: NTIS HC A06/MF A01 CSCL 12B

This report documents a FORTRAN program that provides a powerful and flexible tool for the linearization of aircraft models. The program LINEAR numerically determines a linear system model using nonlinear equations of motion and a user-supplied nonlinear aerodynamic model. The system model determined by LINEAR consists of matrices for both state and observation equations. The program has been designed to allow easy selection and definition of the state, control, and observation variables to be used in a particular model. Author

N88-21741# Sheffield Univ. (England). Dept. of Control Engineering.
PARAMETRIC METHODS OF ANALYSING LINEAR AND NONLINEAR SYSTEMS
S. A. Billings Aug. 1987 34 p Presented at a Short Course on Vibration and Identification of Nonlinear Structures, Edinburgh, Scotland, 16-18 Sep. 1987
(RR-318; ETN-88-92064) Avail: NTIS HC A03/MF A01

Parameter estimation methods for linear systems used in control theory are introduced, and the advantages of an approach based on the NARMAX model are reviewed. In the parametric approach, because the method is based on estimating a NARMAX model it is not input dependent, works for sensible record lengths, and often results in a small parameter set. The evolution of the linearized spectra can be computed. The frequency response functions can be decomposed to show the contribution of, e.g., harmonics. Once identified the system can be simulated in the time or frequency domain to show the response to any input. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-21742# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
PEETRE'S THEOREM AND GENERALIZED FUNCTIONS
J. W. deRoever Oct. 1987 12 p
(MEMO-661; B8729564; ISSN-0921-1962; ETN-88-91835) Avail: NTIS HC A03/MF A01

Sheaf morphisms are considered in sheafs of generalized functions. It is proved that for (ultra) distribution they must be continuous outside discrete points. Contrarily to Peetre's (1960) original theorem (stating that any sheaf morphism in the sheaf of C sup inf functions is a differential operator) which applies to sheafs of test functions, an example makes clear that these points can really be points of discontinuity. It is shown that in the sheaf of hyperfunctions there are more general discontinuous sheaf morphisms. ESA

N88-21743# Technische Hogeschool Twente, Enschede (Netherlands).
LIE GROUPS IN PROLONGATION THEORY Ph.D. Thesis
Hermanus Nicolaas vanEck 1987 96 p
(B8721781; ETN-88-91839) Avail: NTIS HC A05/MF A01

Prolongation theory is introduced, and the explicit form of the Lie algebra of Wahlquist and Estabrook (1975) is presented. The explicit structure of the nonlinear Schroedinger prolongation algebra is discussed. A nonarchimedean approach to prolongation theory is outlined. Prolongation theory in $2+1$ independent variables is considered. ESA

N88-21744# Argonne National Lab., Ill.
THE GLOBAL CONVERGENCE OF PARTITIONED BFGS ON PROBLEMS WITH CONVEX DECOMPOSITIONS AND LIPSCHITZIAN GRADIENTS
A. Griewank Dec. 1987 30 p
(Contract W-31-109-eng-38)
(DE88-006249; ANL/MCS-TM-105) Avail: NTIS HC A03/MF A01

The main pupose of this paper is the extension of Powell's global convergence result to the partitioned BFGS method introduced by Griewank and Toint. Even in the unpartitioned case the original result is strengthened because the search directions need not be computed exactly and the gradient is only required to be Lipschitzian rather than differentiable. Using the PSI - functional of Byrd and Nocedal a strong form of R-superlinear convergence is obtained if the gradients are uniformly convex and strictly differentiable at the minimizer. In order to deal with the possibility of singular functions we utilize a damping of the BFGS update that becomes inactive if the problem turns out to be regular. DOE

N88-21745# Rome Univ. (Italy). Dipt. di Fisica.
THE BIHAMILTONIAN FORMULATIONS OF INTEGRABLE EVOLUTION EQUATIONS IN MULTIDIMENSIONS
P. M. Santini and A. S. Fokas (Clarkson Univ., Potsdam, N.Y.) 9 Oct. 1987 20 p Presented at the Workshop on Nonlinear Evolution Equations and Dynamical Systems, Balaruc Les Bains, France, 1987
(Preprint-568; ETN-88-92259) Avail: NTIS HC A03/MF A01

Aspects of the theory associated with the recursion operators and with the biHamiltonian formulation of integrable evolution equations in an arbitrary number of dimensions are presented, using a bilocal or extended formalism. The notions of symmetries, gradients of conserved quantities, strong, heriditary symmetries, and Hamiltonian operators are generalized to a multidimensional context. Application to physically relevant equations like the Korteweg-de Vries, the Benjamin-Ono, the Kadomtsev-Petviashvili, and the N-wave interaction equations are illustrated. The connection between these integrable systems, nonlocal multidimensional analogs, and matrix evolution equations is also illustrated. ESA

N88-21746# Rome Univ. (Italy). Dipt. di Fisica.
THE TWO-DIMENSIONAL TODA-LATTICE AND ITS RECURSION OPERATORS
O. Ragnisco 30 Oct. 1987 11 p
(Preprint-571; ETN-88-92261) Avail: NTIS HC A03/MF A01

It is shown that the two-dimensional Toda-lattice is endowed with two different recursion operators. These operators are associated with two different nonabelian one-dimensional spectral problems, both of which yield, in suitable limits, the linear problem for the two-dimensional Toda-lattice. ESA

N88-21747# Rome Univ. (Italy). Div. of Physics.
ALGEBRAIC STRUCTURE OF LINEAR AND NONLINEAR MODELS OF OPEN QUANTUM SYSTEMS
A. Jannussis (Patras Univ., Greece) and R. Mignani 6 Nov. 1987 15 p
(Preprint-573; ETN-88-92263) Avail: NTIS HC A03/MF A01

It is shown that the linear and nonlinear evolution equations proposed for the density operator of open quantum systems admit a common algebraic structure in the form of a generalized commutator, which is the nonassociative product of a Lie-admissible algebra. The main advantages of the Lie-admissible formalism are due to its admitting a consistent algebraic structure (of the Lie-admissible type) in the brackets of the time evolution. This allows one to recover for open systems most of the standard properties of conservative systems, which are generally lost (due to the lack of algebraic character) in the usual treatments. They include, for instance, a consistent group structure in the exponentiated form of the evolution law; the unitarity of the time-development operators; the invariance in form of the evolution law under the time evolution itself. All of these features can be recovered, although in a generalized sense, in the Lie-admissible treatment of open systems. ESA

N88-21748# Rome Univ. (Italy). Dipt. di Fisica.
ON GENERALIZED LIE-LIKE ALGEBRAS
A. K. Kwasniewski 10 Nov. 1987 6 p Sponsored in part by Rome Univ., and Wroclaw Univ., Poland
(Preprint-574; ETN-88-92264) Avail: NTIS HC A02/MF A01

The theory of generalized Lie-like algebras is developed due to the application of algebra extensions of abelian groups. The cohomological classification of the introduced structures is given, Poincare-Birkhoff-Witt theorem is proved. ESA

N88-21749# Rome Univ. (Italy). Dipt. di Fisica.
MIXING COEFFICIENTS OF THE LATTICE WEAK HAMILTONIAN WITH DIMENSION FIVE OPERATORS
G. Curci, E. Franco, L. Maiani, and G. Martinelli (European Organization for Nuclear Research, Geneva, Switzerland) 30 Nov. 1987 19 p Sponsored in part by the Italian Ministry of Public Education and the Istituto Nazionale di Fisica Nucleare
(Preprint-576; ETN-88-92265) Avail: NTIS HC A03/MF A01

The mixing coefficients of the four fermion operators which appear in the nonleptonic Delta S = 1, octet Hamiltonian with operators of dimension five is computed. This calculation completes the construction of the perturbative part of the weak Hamiltonian, to be used in Monte Carlo simulations of lattice QCD with Wilson fermions. ESA

N88-21750# Rome Univ. (Italy). Dipt. di Fisica.
RECURSION OPERATOR AND BACKLUND TRANSFORMATION FOR THE RUIJSENAARS-TODA LATTICE
M. Bruschi and O. Ragnisco 30 Nov. 1987 12 p Sponsored in part by the Italian Ministry of Public Education
(Preprint-577; ETN-88-92266) Avail: NTIS HC A03/MF A01

The recursion operator and the whole class of Backlund transformations for a relativistic version of the Toda-lattice introduced by Ruijsenaars (1986) are shown. The results are used to prove the complete integrability of the system and to provide an explicit solution of the equations of motion. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-21751# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: PHYSICS AND MATHEMATICS Abstracts Only
12 Feb. 1988 35 p Transl. into ENGLISH from various Russian articles
(JPRS-UPM-88-001) Avail: NTIS HC A03/MF A01

Summaries of articles from the open literature are presented in the areas of acoustics, crystals, laser glasses, semiconductors, lasers, molecular physics, nuclear physics, optics, spectroscopy, plasma physics, superconductivity, and theoretical physics. For individual titles, see N88-21752 through N88-21780.

N88-21752# Joint Publications Research Service, Arlington, Va.
ADDITIONAL PEAK OF LIGHT SCATTERING BY SOUND UNDER CONDITIONS OF ACOUSTIC INSTABILITY Abstract Only c71
D. V. Kagan and A. F. Ioffe *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 1 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, Apr. 1987 p 1199-1202 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

A mathematical model is constructed for explaining the appearance of an additional peak of light scattering by sound when the latter fluctuates under conditions of instability. The underlying theory stipulates formation of another diffraction grating in addition to the ordinary Mandelshtam-Brillouin grating and

associates the additional scattering peak with diffraction by this new grating so that the laws of wave vector and frequency conservation are circumvented. A phonon distribution and a wave vector distribution are considered which have not only a smooth part but also a sharp peak at some value of the wave vector. The theory is proved on this basis by first assuming that both distributions are not functions of the space coordinates, as may be the case in a highly turbulent medium, and then recognizing that both distributions grow to saturation as they vary in space. The gist of the proof lies in calculation of the differential extinction coefficient according to Landau-Lifshits for scattering of plane waves. Author

N88-21753# Joint Publications Research Service, Arlington, Va.
EFFECT OF Mg IMPURITY ON LOCAL VIBRATIONS OF U-CENTERS IN LiF LATTICE Abstract Only c76
L. I. Bryukvina and V. M. Khulugurov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 1 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, May 1987 p 1525-1526 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study of LiF crystals with OH(-) ions perturbed by an Mg impurity was made which revealed additional lines along the quiescent U-center line in their infrared absorption spectrum. The crystals had been grown by the Kiropulos method with MgF2 added during the process. Their spectrum was measured in a Ur-20 spectrophotometer at room temperature. Here the 3730/cm absorption band of quiescent OH(-) ions was missing, but the Mg(++)OH(-) complex was found to have produced a strong 3575/cm line as well as weak 3545/cm and 3630/cm peaks. The crystals were then exposed to gamma-radiation from a Co-60 source. A dose of 10 to the 8th power R weakened those three absorption lines while producing wide absorption bands within the 180 to 3500/cm range and exciting U-centers at a frequency of 1015/cm. Subsequent annealing with the temperature raised in 50SDC steps up to 350SDC intensified absorption within that band, annealing at temperatures from 150SDC up also producing additional absorption peaks. Author

N88-21754# Joint Publications Research Service, Arlington, Va.
NEW METHOD OF EXAMINING MICRONONHOMOGENEITY OF LOCAL CENTERS IN HIGH-RESISTIVITY SEMICONDUCTOR MATERIALS UNDER SCANNING ELECTRON MICROSCOPE Abstract Only c76
A. V. Govorkov, E. M. Omelyanosvskiy, A. Ya. Polyakov, V. I. Raykhshteyn, and V. A. Fridman *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 2 Transl. into ENGLISH from Pisma v Zhurnal Fiziki (Leningrad, USSR), v. 13, no. 7, 12 Apr. 1987 p 385-388 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Photoelectric relaxation spectroscopy of high-resistivity semiconductors, photocurrent relaxation in a structure with a Schottky barrier and constant reverse bias being recorded after that structure has been excited by a radiation pulse, can be used for examining the microninhomogeneity of local centers in such semiconductors under a scanning electron microscope. This application was demonstrated on GaAs chips with In impurity such as for LSI technology. On the relaxation curve the initial fast current decrease, owing to recombination and leakage of excess charge carriers, is followed by a long tail representing a thermal mechanism by which carriers trapped in the space-charge region jump into an allowed band. In the experiment for the first time an electron beam was used for excitation of GaAs:In structures, reverse bias of the Schottky barrier being provided through a current amplifier. The photocurrent relaxation transient after the end of an excitation pulse was recorded with the aid of an electronic probe at various temperatures, typically at 85 K and 240 K. The readings were processed by a computer with an automatic graph plotter for the construction of spectra with different time windows and peak intensities at different temperatures corresponding to different concentrations and energy levels of deep centers. Author

N88-21755# Joint Publications Research Service, Arlington, Va.
INFRARED REFLECTION-ABSORPTION SPECTROSCOPY OF HYPERFINE LAYERS ON SURFACES OF SEMICONDUCTORS AND DIELECTRICS Abstract Only c76
S. N. Gruzinov and V. P. Tolstoy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 3 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 5, May 1987 p 775-780 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Infrared reflection-absorption spectroscopy of film son surfaces of transparent or weakly absorbing semiconductor and dielectric substrates is analyzed theoretically, the purpose being to establish the conditions for maximum sensitivity of this method. The absorption factor, namely the relative change of the reflection coefficient upon formation of a film on the substrate surface, is selected as the sensitivity criterion. The analysis is based on exact relations, one for a homogeneous isotopic absorbing film between substrate and ambient medium with plane-parallel boundaries and one for a reflecting layer with the possibility of multiple reflections taken into account. Calculations have been programmed on a computer for up to 60 nm thick SiO2 films on various substrates and infrared radiation within the 8 to 11 gmm waveband. The results indicate that the dependence of the absorption factor on the radiation wavelength and on the film thickness is different with the radiation s-polarized than with the radiation p-polarized. Calculations have also yielded the dispersion of optical constants characterizing a SiO2 film. According to these results, infrared spectroscopy is most sensitive to films on substrates with a small refractive index and when done with p-polarized radiation incident at exactly or approximately the Brewster angle for a determination of their presence and their composition respectively, also when no multiple reflections occur. Author

N88-21756# Joint Publications Research Service, Arlington, Va.
BLOCH OSCILLATIONS IN SMALL JOSEPHSON JUNCTIONS: THEIR MANIFESTATION IN SWITCHING EFFECTS Abstract Only c76
R. O. Starobogatov and G. Yu. Yashin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 3-4 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, May 1987 p 1580-1582 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Switching-on the current through a small Josephson junction, a current larger than critical I sub 0=/-gpgD/eR sub tau (gD - lower tunneling band, e - electron charge, R sub tau - dynamic junction resistance) is analyzed and the transient current-voltage characteristic is shown to have not only a drooping range with oscillations near current resonance but also a voltage harmonic of the same frequency immediately after time t = 0. This bell effect is demonstrated theoretically by describing the state of such a junction according to the one-band model with an analog of the conditional-probability distribution function, such as that in the Volterra equation, which satisfies the Fokker-Planck equation. This equation is solved exactly for the simple case of a lower tunneling band much narrower than the energy gap and with steady state as the initial condition. The voltage harmonic is then calculated with the aid of Josephson's second law. Author

N88-21757# Joint Publications Research Service, Arlington, Va.
RADIATION ABSORPTION IN NEODYMIUM GLASSES DURING PASSAGE OF STRONG LASER PULSE Abstract Only c36
V. V. Ivanov, Yu. V. Senatskiy, and G. V. Sklizkov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 410-412 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Selective radiation absorption in neodymium glasses was recorded experimentally during passage of a laser pulse of 0.5 to 0.7 ns duration with 2 to 5 J/sq cm energy density coming from

a YAG:Nd(3+) laser oscillator with periodic Q-switching, after amplification by two YAG:Nd(3+) stages and one GLS-9P glass stage with subsequent spatial filtration by a relay. A weak probing pulse synchronized and aligned with the strong pumping pulse was generated by an auxiliary oscillator with YAG:Nd(3+) crystals and KNPS glass. This probing pulse revealed absorption of radiation in rods of phosphate glasses and of silicate glasses containing Nd(3+) activator ions. From the changes in both intensity and profile of a probing pulse after two passages through a glass rod 2 mm in diameter selective absorption of radiation at three wavelengths within the transparence window of neodymium glasses was determined. An absorption jump was recorded at the gl sub 1 = 0.66 gmm radiation wavelength. Induced absorption was found in phosphate glasses at a power density of 3.6 GW/sq cm and in silicate glasses at a power density of 5.2 GW/sq cm. Selective absorption of 0.55 gmm and 1.053 gmm radiation can be associated with transition in the Nd(3+) ion as a result of nonlinear processes in the glass, induced absorption being attributable to small-scale self-focusing. Author

N88-21758# Joint Publications Research Service, Arlington, Va.
NONLINEARLY TUNABLE WIDEBAND EMISSION OF INFRARED RADIATION BY Al2O3:Ti LASER Abstract Only c36
D. V. Bakin, L. M. Dorozhkin, Yu. I. Krasilov, N. T. Kuznetsov, and A. V. Shestakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5 Transl. into ENGLISH from Optika i Spektroskopiya (Leningrad, USSR), v. 62, no. 4, Apr. 1987 p 891-893 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

A tunable coherent source of infrared radiation can be produced by use of an Al2O3:Ti crystal as laser-converted and pumping it with second-harmonic radiation from a YAG:Nd laser. A study was made on this premise pertaining to the feasibility of a coherent radiation source tunable over the 1.2 to 12 gmm range based on the gq2-gq3 or gq3-gq1 difference-frequency generating mechanims. Results reveal that gq2-gq3 is most efficiently generated by eo-0 interaction in a LiNbO3 or Ba2NaNb5O15 mixer crystal, with possible control of noncritical phase synchronism, only eo-0 interaction with gl2-wave as the e-wave being possible in such a crystal, and a YAG:Nd laser with Q-switching at a frequency of 1 Hz. The Al2O3Ti crystal was placed inside a plane-parallel cavity. The pumping second-harmonic radiation was focused by a lens on the interior of this crystal, which then absorbed 80 percent of the radiation. At the gl3 = 0.8 gmm optimum emission wavelength the emission line was 20 nm wide and the efficiency of the Al2O3:Ti laser reached 12 percent, with a 20 ns delay from pump pulse peak to emission pulse peak. This delay could be shortened by raising the pump pulse energy. Author

N88-21759# Joint Publications Research Service, Arlington, Va.
TIME CHARACTERISTICS OF ULTRASHORT LIGHT PULSES FROM DYE LASERS WITH DISTRIBUTED FEEDBACK Abstract Only c36
A. N. Rubinov, B. A. Bushuk, and A. L. Berestov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 5-6 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 906-909 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study was made of distributed feedback dye lasers excited by picosecond pulses from a solid-state laser, for the purpose of determining the time characteristics of their ultrashort emission pulses. Two dye lasers were tested, one with ethanol solution of rhodamine 6G and one with ethanol solution of oxazine 17 as active medium. YAG:Nd(3+) laser set consisting of a master oscillator with passive mode locking was used as the pump together with a monopulse extractor, and two amplifier stages. Radiation from the pump laser was passed through a KDP crystal for frequency conversion into second-harmonic pulses of 5 mJ energy and 30 ps duration. Measurements were made which yielded the dependence of the time delay from pump pulse to emission pulse and of the emission pulse duration on the wavelength of emission pulses. Also measured was the dependence of that time delay on the ratio of pump energy to threshold level over the 2 to 10 range, with the rhodamine laser tuned to the 566 nm wavelength. Results indicate the optimum conditions for ensuring low instability of emission time delay and emission pulse duration attainable by distributed feedback dye lasers. Author

N88-21760# Joint Publications Research Service, Arlington, Va.
KINETICS OF SLOW ELECTRONS IN EXCIMER LASER WITH ELECTRON-BEAM PUMPING Abstract Only c36
V. A. Adamovich, V. A. Demyanov, N. A. Dyatko, I. V. Kochetov, A. P. Napartovich, and A. P. Streltsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 6 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 5, May 1987 p 937-942 Original language document was announced in IAA as A87-50835 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Gas mixtures with Ar as principal component used as active media of excimer lasers are considered, of concern being the kinetics of slow electrons in such lasers with electron-beam pumping. The corresponding Boltzmann equation and equations of ion-molecular kinetics are solved simultaneously for the low-energy part of the electron energy-distribution function. The kinetic model of such an excimer laser is constructed on this basis, first for the simplest case of pure Ar and then for Ar with an active gas such that dissociative attachment of electrons to its molecules can serve as measure of the electron concentration. Experiments were performed with an Ar:CCl4 and Ar-Xe-HCl mixtures. A kinetic model is presented, on the basis of which is calculated the electron-beam current density as a function of time for a pumped Ar:Xe:HCl mixture. Lowering of the attachment frequency is found to increase the low-energy fraction of beam electrons and thus to decrease the mean beam energy. Complete elimination of attachment, by removal of HCl, is found to lower the mean beam energy still further. So can photoionization and photodetachment. The form of the energy distribution function for plasma electrons was found not to change appreciably with change of the energy spectrum of the low-energy electron source from a Gaussian to a rectangular or triangular one. Author

N88-21761# Joint Publications Research Service, Arlington, Va.
SOLID-STATE RING LASER WITH ACOUSTOOPTICAL PHASE NONRECIPROCITY OF OPPOSING WAVES Abstract Only c36
Yu. D. Golyayev, A. A. Zadernovskiy, and A. L. Livintsev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 6-7 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 917-919 Original language document was announced in IAA as A88-10757 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experiment was performed with a YAG:Nd(3+) ring laser and an acoustooptic device for maintenance of phase nonreciprocity of opposing light waves interacting with each other as well as with the traveling component of the ultrasonic wave. An AOM-1 acoustooptic modulator of light intensity with the traveling ultrasonic wave of constant power continuously present was first used as the phase nonreciprocator. The results indicate suppression of one of the opposing waves upon introduction of phase nonreciprocity. The experiment was repeated with locking of longitudinal modes by means of an ML-202 acoustooptic device instead of light intensity modulation. Results indicate that in this case phase nonreciprocity becomes zero and bidirectional emission of light waves with nearly equal intensities begins as the orientation gv of the acoustooptic mode locking device deviates more than approximately 6 minutes from the Bragg angle. Author

N88-21762# Joint Publications Research Service, Arlington, Va.
EMISSION CHARACTERISTICS OF XeCl-LASER EXCITED BY ELECTRON BEAM OF MICROSECOND DURATION Abstract Only c36

Yu. I. Bychkov, N. G. Ivanov, V. F. Losev, G. A. Mesyats, and V. V. Ryzhov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 7 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, nop. 5, May 1987 p 953-956 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study of a XeCl laser excited by an electron beam of microsecond duration was made for a determination of its space and time as well as energy characteristics including relation between emission and excitation parameters. The active medium, an HCl:Xe:Ar gas mixture, was excited by an electron beam from an accelerator with a sputter-emission cathode. The results have yielded the specific excitation energy as a function of time over the 1.3 gms pulse duration period and as a function of the distance from the film-window up to 14 cm inside the chamber, with the Ar pressure varied over the 1 to 3 atm range. The specific emission energy was found to decrease with increasing distance from the film-window, from a higher initial value at the window and at a faster rate as the Ar:HCl or Ar:CCl(4) ratio was decreased. The results reveal a generally nonuniform excitation of the active medium by an electron beam, which makes optimization of the laser performance difficult, and that at low excitation levels the Cl content necessary for an optimum gas mixture decreases with docreasing excitation power. Author

N88-21763# Joint Publications Research Service, Arlington, Va.
EFFECTS OF EMISSION ENERGY TRANSIENT IN PERIODIC-PULSE XeCl EXCIMER LASER OF APPROXIMATELY 400 W AVERAGE POWER Abstract Only **c36**
V. M. Borison, A. Yu. Vinokhodov, and Yu. B. Kiryukhin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 7-8 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 936-942 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study of the periodic-pulse XeCl excimer laser with electric-discharge pumping was made, for an analysis of the emission energy transient and a comparative evaluation of two buffer gases. The excitation system consisted of two independent identical electric circuits and two gas-discharge spaces with a common ground-potential electrode but with a separate high-potential electrode each, all electrodes made of stainless steel. Reliable switching was ensured by use of hydrogen-filled thyratrons. Tests were performed with two gas mixtures, namely a conventional HCl:Xe:He-1:101000 one and a new HCl:Xe:Ne-1:10:1200 one. The total pressure was varied over the 2 to 4 atm range. The ratio of peaking capacitance to storing capacitance in the discharge ciruit was 0.6 for He as buffer component and 1.0 for Ne as buffer component under a total pressure of 4 atm. Sequences of emission pulses at repetition rates of 100 to 5900 Hz building up to a steady-state average power were recorded on oscillograms. An evaluation of the data reveals the advantages of Ne over He as buffer component, namely a much better maintenance of discharge uniformity and a higher attainable steady-state average power of 420 W approaching that attainable in the monopulse emission mode. Author

N88-21764# Joint Publications Research Service, Arlington, Va.
TUNABLE CONDENSED-MEDIA LASER WITH ANTIRESONANT RING CAVITY Abstract Only **c36**
G. S. Kruglik, A. A. Kutsak, G. A. Skripko, V. R. Sender, N. V. Kondratyuk, and L. P. Zharikhina *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 8 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 5, May 1987 p 727-732 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An antiresonant ring cavity with negative feedback is considered for tuning a condensed-media laser. The performance of such a cavity is analyzed comparatively with that of a linear one. The field inside the cavity is resolved into those of individual modes and is described by corresponding equations of balance. The resulting system of equations is solved, with the relative populations of all levels adding up to unity, using specific numerical data applicable to a rhodamine-6G dye laser. On this basis is calculated the nonreciprocity index on the reflection coefficient of the exit mirror and, for a 50-reflectance exit mirror, the dependence of the emission energy on the distance from that mirror to the high-reflectance mirror behind it. Results indicate that stable emission of two waves traveling in opposite directions with mutually aiding interaction and a thus nearly constant nonreciprocity index is more likely in an antiresonant ring cavity than in a conventional one, the selectivity of an antiresonant ring cavity being higher than that of a linear one. They also indicate, however, that the emission energy depends more strongly on the distance between the exit mirror and the mirror behind it in an antiresonant ring cavity than in a linear one, the emission energy increasing as the distance is decreased. Author

N88-21765# Joint Publications Research Service, Arlington, Va.
NONLINEAR STAGE OF ULTRASHORT-PULSE FORMATION IN SOLID-STATE LASER Abstract Only **c36**
M. I. Demchuk, I. A. Manichev, V. P. Mikhaylov, and K. V. Yumashev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 9 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 4, Apr. 1987 p 562-567 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Formation of ultrashort pulses in a YAG:Nd(3+) laser is considered, particularly in nonlinear stage. The dependence of the resulting pulse duration on the length of this stage as well as on the length of the free-emission stage and on the density of a passive shutter is evaluated on the basis of experimental data and computer-aided numerical analysis of the applicable theoretical relation. Results reveal that it is possible to decrease the duration of ultrashort pulses by lengthening the nonlinear stage and shortening the linear one, under two-threshold condition, and that sufficient lengthening of the nonlinear stage will eventually saturate the shutter effect. Lowering the density of some shutters such as 4050 film in polymethyl methacrylate was found to decrease the pulse duration, while lowering the density of others such as 3274 dye in acetone solution increases it. Author

N88-21766# Joint Publications Research Service, Arlington, Va.
HIGH-EFFICIENCY Y-Sc-Ga:Cr (SUP)3+,Tu (SUP)3+,Ho (SUP)3+ GARNET LASER (gl= 2.088 gmm AT ROOM TEMPERATURE Abstract Only **c36**
A. N. Alpatyev, Ye. V. Zharikov, S. P. Kalitin, A. F. Umyskov, and I. A. Shcherbakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 9 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 922-923 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Improvements have been made on the pulsed laser at the Ho 5/7 to 5/8 transition in a Y-Sc-Ga garnet crystal with optical pumping at room temperature. A cylindrical garnet crystal 4 mm in diameter and 76 mm long was doped with Cr(3+) and Tu(3+) ions as well as Ho(3+) ions. Such a crystal was placed inside a 24 cm long cavity between two plane mirrors with dielectric coating, each one having a 99.23 reflectance and the exit mirror having a 50 reflectance. Without coating on its front and back surfaces, the crystal was pumped over a 72 mm long segment by a INP-5/75A xenon lamp in an elliptical monoblock made of silver-coated yellow quartz filtering out ultraviolet radiation. It was cooled with 0.1K2CrO4 solution in H2O acting also as supplementary filter. The nearly square pumping pulses were of 1.4 gms duration and thus much shorter than the 13 gms lifetime of the excited Ho(3+) state. The emission threshold was found to be 63 J pump energy. Free emission at a wavelength within the 2008 plus or minus 4 nm band with a differential efficiency of 3.1 was attained by pumping with pulses of 142 J energy at a repetition rate of 1 Hz, the maximum absolute efficiency of 2.1 having been attained by pumping with pulses of 253 J energy

and the maximum emission energy of 7.4 J having been attained by pumping with pulses of 395 J energy. Author

N88-21767# Joint Publications Research Service, Arlington, Va.
SPACE-TIME STRUCTURE OF ULTRASHORT LIGHT PULSES FORMED DURING STIMULATED BACKSCATTERING OF LASER BEAM Abstract Only **c36**
E. Gayzhauskas, A. Piskareskas, V. Smilgyavichyus, and K. Stalyunas *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 1025-1030 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Conditions for optimum compression of nanosecond light pulses by stimulated Mandelstam-Brillouin backscattering of a focused laser beam in an active medium are analyzed theoretically. Calculations are based on a system of two short equations which describe interaction of an incident pump wave and the reflected Stokes wave during quasi-steady stimulated Mandelstam-Brillouin scattering, assuming slow envelopes. The dependence of the energy reflection coefficient and the pulse compression ratio on the excess of the actual pump energy above the emission threshold level and on the focusing angle is derived together with the space-time structure of a reflected Stokes pulse and its dependence on the focusing angle. The results indicate how compression of nanosecond light pulses into subnanosecond ones can be optimized, namely by use of a uniform incident laser beam with suboptimum pump energy less than twice the threshold level for the scattering medium and by its wide-angle focusing so as to minimize the space-time nonuniformity of the reflected Stokes pulse. High compression ratios of the order of 10 are attainable with two or more compression and amplification stages. Author

N88-21768# Joint Publications Research Service, Arlington, Va.
CONTROLLING XeCl-LASER BY MEANS OF EXTERNAL SIGNAL WITH LESS THAN 2 W/cm (SUP)2 INTENSITY Abstract Only **c36**
Yu. I. Bychkov, M. L. Vinnik, S. Ye. Kovalenko, and V. F. Losev *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 10 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 957-958 Original language document was announced in IAA as A88-10764 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

The conditions for controllability of a XeCl laser by synchronous injection of a signal from a master laser have been established. The injection efficiency was found to reach a maximum of 95 with an external signal of 2 W/sq cm intensity and to drop to zero, corresponding to loss of controllability, with an external signal of 7 mW/sq cm or lower intensity. It was also found to drop appreciably when the time difference between filling the controlled-laser cavity with radiation from the master laser and reaching the controlled-laser emission threshold exceeded + or - 4 ns. Author

N88-21769# Joint Publications Research Service, Arlington, Va.
ALFVEN WAVES IN PLASMA WITH FINITE ION TEMPERATURES Abstract Only **c75**
V. P. Lakhin, A. B. Mikhaylovskiy, and A. I. Smolyakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 13 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 92, no. 5, May 1987 p 1612-1617 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

A hydrodynamical description of nonlinear Alfven waves is sought which will also cover Alfven vortices in a plasma with the ion temperature higher than the electron temperature and the ratio of plasma pressure to magnetic field pressure larger than the ratio of ion mass to electron mass. Assuming that the Larmor radius as well as the temperature of ions are finite, a system of nonlinear equations of the Grad kind is found to be adequate where equations of the Braginskiy kind are not. This system reduces to a single equation, inasmuch as the dispersion of Alfven waves is weak and thus approximately linear. This equation is linear for standing waves and remains so for waves traveling in opposite directions from singular lines. Its solution demonstrates the existence of Alfven dipole vortices, which belong in the class of degenerate bipotential ones. Author

N88-21770# Joint Publications Research Service, Arlington, Va.
THEORY OF MUON METHOD FOR STUDY OF SOLID AND LIQUID HYDROGEN Abstract Only **c72**
Yu. M. Belousov and V. P. Smilga *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 15 Transl. into ENGLISH from Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 92, no. 4, Apr. 1987 p 1151-1159 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Exothermic reaction H2+gm(+)-(H2gm)(+)+4.5 eV as well as less likely endothermic exchange reactions Mu+H2-MuH+H or gm(+)+H2-MuH+H(+) are considered for study of solid and liquid hydrogen. The spin density matrix with appropriate formulation of the spin Hamilton is evaluated, for an analysis of the behavior of muon polarization in the diamagnetic (H2gm)+ ion frozen into the c.p.h. lattice and subsequent analysis of internal spin interaction. Depolarization, occurring at about the same rate of the order of 100,000/s in solid para-hydrogen in a solid ortho-hydrogen, is shown to be slowed by rotational diffusion of the (H2gm)(+) ion. Depolarization in liquid hydrogen is known to be slowed down by Brownian movement of the ice shell forming around the (H2gm)(+) ion. Depolarization should theoretically, therefore, become much slower during melting of hydrogen. This has been confirmed experimentally. Author

N88-21771# Joint Publications Research Service, Arlington, Va.
HOLOGRAPHIC DISK FOR DATA STORAGE Abstract Only **c35**
A. L. Mikaelyan, A. F. Vanin, E. Kh. Gulanyan, and S. A. Prokopenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 19-20 Transl. into ENGLISH from Kvantovaya Elektronika (Moscow, USSR), v. 14, no. 5, May 1987 p 1074-1085 Original language document was announced in IAA as A88-10782 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

The feasibility of high-density data storage on a holographic disk is examined on the basis of appropriate schemes for recording and readout of digital optical signals. Equipment necessary and available for this purpose is described, the performance of principal component devices being evaluated for optimization with reference to signal and carrier characteristics as well as to holograph geometry. Theoretical analysis of the problem and the experimental results already reported indicate the scope of applications for the holographic disk and attainable disk quality for data storage. Author

N88-21772# Joint Publications Research Service, Arlington, Va.
THREE-WAVE PARAMETRIC RESONANCE IN PLASMA OF RELATIVISTIC ELECTRON FLUX Abstract Only **c75**
T. A. Davydova, V. P. Zakharov, and V. V. Kulish *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 21 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 4, Apr. 1987 p 687-694 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Three-wave parametric resonance in the plasma of a relativistic electron flux is treated in terms of Raman or Compton interaction and development of burst-like instabilities with the amplitudes of interacting waves increasing nonlinearly after the linear stage is demonstrated to occur during Compton interaction. A system of five nonlinear first-order differential equations for slowly varying complex amplitudes is obtained. In the Raman mode, only one of two slowly decaying space-charge waves participates in resonance

with electromagnetic waves. In the Compton mode, as the pump amplitude becomes so large that the ponderomotive potential exceeds the space-charge potential, both waves participate equipotently in resonance with electromagnetic waves. Instabilities in Compton mode are calculated with the aid of modified Manly-Rowe integrals and the condition for synchronism. At the point of burst-like instability, the amplitudes of space-charge waves decrease in the same manner as in the Raman mode, but the amplitudes of electromagnetic waves increase much faster. Such an instability is shown to develop only in a non-equilibrium medium with the energy of a relativistic electron flux, for instance, as the source of unbalance. Author

N88-21773# Joint Publications Research Service, Arlington, Va.
EFFECT OF FLOW CONVERGENCE ON TURBULENCE LEVEL IN STREAM Abstract Only **c02**
G. I. Derbunovich, A. S. Zemskaya, Ye. U. Repik, and Yu. P. Sosedko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 21 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Mekhanika Zhidkosti i Gaza (Moscow, USSR), no. 2, Mar. - Apr. 1987 p 146-152 Original language document was announced in IAA as A87-41846 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study of stream contraction in interchangeable converging nozzles of a subsonic wind tunnel was made for the purpose of determining the effect of such a contraction on the turbulence level in the diffuser. A theoretical evaluation of the experimental data, indicating negligible degeneracy of turbulence in the nozzle on account of molecular viscosity, has yielded semiempirical relations for the decay of turbulence along the channel: gy(x/M)-0.95 at x/M and gy(x/M)-0.7 at (x/M)-20 (x/M - distance from end of contraction zone, referred to mesh size of turbulizing grid), with the equivalent turbulence suppression coefficient F asterisk = C 4/3. Author

N88-21774# Joint Publications Research Service, Arlington, Va.
PULSE DURATION CONTROL OF XeCl*-LASER BY MEANS OF PLASMA SHUTTER Abstract Only **c36**
A. N Panchenko and V. F. Tarasenko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 23 Transl. into ENGLISH from Fizika Plazmy (Moscow, USSR), v. 13, no. 4, Apr. 1987 p 497-498 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

For the first time a plasma shutter was used for pulse duration control of a XeCl*-laser, radiation pulses being shortened here by the plasma of an opaque target material closing a hole made in the target. Experiments were performed with a LIDA-10 XeCl* exciplex laser, which normally emitted pulses of 60 ns duration with up to 2 J energy. The radiation was focused by a 10 cm long lens on the target so as to ignite a plasma at surface of the latter, over a spot 1 mm in diameter. Thin metal and dacron films were first used as the target in which the laser beam burned out holes. Pulse compression occurred during the first few shots, after which the holes widened sufficiently to render such a shutter ineffective. Next, 1 mm thick plates of metal, tin, and lead, already having holes approximately 0.1 mm in diameter were used as the targets. Within plates it was possible to shorten the duration of 0.1 J pulses to 7 ns and to lengthen the shutter life to tens of pulses. This shutter was found to be much more effective than 1 mm thick saturable filter made of RVD dye in ethanol solution. Author

N88-21775# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTING TRANSITION TEMPERATURE OF Cu-Nb MICROCOMPOSITES Abstract Only **c76**
I. A. Kiyanskiy, T. I. Bryushkova, Yu. F. Bychkov, and A. Ya. Zhiltsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 25 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, Apr. 1987 p 1203-1205 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

An experimental study of Cu-Nb microcomposites was made, its purpose being to determine the dependence of their superconducting transition temperature on the structure and the Nb content. Specimens with 20 percent Nb and with 40 percent Nb were produced. Sintered compacts were drawn into wires 3.4 to 0.16 mm in diameter. The superconducting transition temperature was determined accurately within 0.2 K by the induction method with a carbon thermometer which had been calibrated against a Ge resistance thermometer and critical temperatures of several metals and alloys as reference points. The readings are compared with those pertaining to Nb fibers 3.4 to 0.16 gmm in diameter extracted from wires of correspondingly 1000 times larger diameter. The coherence radius was determined on the basis of measurement of the electrical resistance of the Cu matrix at a temperature between 4.2 K and 50 K, which yielded 0.05 gmm at 4.2 K. The results indicate two critical temperatures with a characteristic resistivity plateau between them for specimens without residual resistivity and thus becoming perfect superconductors. They also indicate that the temperature range of superconducting transition becomes narrower with a higher Nb content, with the plateau eventually vanishing, evidently owing to a closer packing of Nb fibers. Author

N88-21776# Joint Publications Research Service, Arlington, Va.
THERMAL MODEL DESCRIBING DEVELOPMENT OF NORMAL REGION IN SUPERCONDUCTOR FILM CARRYING ELECTRIC CURRENT Abstract Only **c76**
O. G. V ndik, O. V. Pakhomov, and L. L. Tereshchenko *In its* JPRS .eport: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 26 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 4, Apr. 1987 p 663-668 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Development of a normal region by laser radiation in a superconductor film carrying electric current is analyzed on the basis of experimental data and a mathematical model. Thick Nb films were deposited on leucosapphire substrates by electron-beam vacuum evaporation. Transition to normal state occurred at a current ranging from 100 mA without irradiation down to zero at some critical radiation power, recovery of the superconducting state occurring at a current of 1.43 mA in the absence of radiation. The dependence of the velocity of the two S-N transition fronts propagating along a microconstriction on the electric current through the latter and on the power of impinging radiation is interpreted theoretically on the basis of a thermal model, a system of three analogous differential equations of heat conduction for the three successive regions with appropriate boundary conditions, with the N region symmetrically at the center and heat flowing from it downward through the substrate to a heat sink. For a quantitative evaluation of this thermal S-N transition mechanism, the thermophysical parameters of an Nb-Al2O3 structure are calculated on the basis of experimental data and in accordance with superconducting transition theory. These parameters are thermal conductivity of the film-substrate junction, heat spreading distance and effective thermal conductivity along the film, and effective coefficient of thermal diffusion. Author

N88-21777# Joint Publications Research Service, Arlington, Va.
GIANT JOSEPHSON SIGNAL IN WIDE SUPERCONDUCTING FILMS Abstract Only **c76**
Yu. M. Ivanchenko, P . N. Mikheyenko, and Ya. I. Yuzhelevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 27 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (USSR), v. 45, no. 10, 25 May 1987 p 483-486 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Synchronous movement of multiquantum magnetic flux tubes appearing in thin current-carrying films of type-II superconductors such as In according to Josephson's law is proposed to be the mechanism of giant-signal generation. This theory is based on an

experiment which has revealed oscillations in such films with the second critical magnetic field intensity more than two orders of magnitude higher than that for thick In layers. The experiment was performed on microbridges with nonuniform thickness and on microbridges with constriction, their length and width respectively about equal to and much larger than the 1/100 cm characteristic thermal distance defined as width of the ban with a temperature gradient. Measurement of the current-voltage characteristics has revealed a sharp transition from a steep first drooping to a less steep second drooping range with giant oscillations which cease as the voltage reaches the 2T'gD/e=0.5mV levels (T' - temperature in flux-crowding region, gD - order parameter, e - electron charge). According to this model, the velocity of the magnetic flux tubes does not depend on the frequency if the latter is limited by the distance between magnetic flux tubes, which cannot be larger than the characteristic thermal distance, so that the ratio of maximum frequency to minimum frequency is equal to the ratio of microbridge width to characteristic thermal distance. Author

N88-21778# Joint Publications Research Service, Arlington, Va.
ORGANIC METAL (ET)4Hg3Br8A QUASI-TWO-DIMENSIONAL SUPERCONDUCTOR Abstract Only **c76**
R. N. Lyubovskaya, Ye. A. Zhilyayeva, A. V. Zvarykina, V. N. Laukhin, R. B. Lyubovskiy, and S. I. Pesotsky *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 26 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 416-418 Original language document was announced in IAA as A87-52815 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

The first salt of bis-(ethylene dithio tetrathiavulvalene) with the (Hg3Br8)(-2) exchange anion, upon transition into the superconducting state, has been found to be a quasi-two-dimensional superconductor. It has also been found to exist in at least three phases: a dielectric one already at room temperature, a dielectric one below 180 K, and an (ET)4Hg3Br8 phase still metallic at temperatures near zero. This metallic phase is a crystalline one with a rhombic lattice typically 0 to 0.5 mm thick and 0.5 to 2 mm wide along the diagonals. Direct resistance measurements at a temperature of 300 K have yielded a longitudinal electrical resistivity of 150 to 300 ohm cm and a transverse electrical resistivity of 0.2 to 2 ohm cm, this anisotrophy increasing further with a lowering of the temperature. Wide temperature ranges of the transitions and soft bends of the resistance-temperature curves indicate a nonhomogeneity of (ET)4Hg3Br8 specimens owing to existence of either two different superconducting phases or regions with large internal stresses. Existence of two superconducting phases corroborated by the trend of superconductivity suppression by a transverse magnetic field, the resistance (R1)-field(H1) curve having one bend within the 4.2 to 3 K temperature range and two bends at higher temperatures. Assuming that a bend corresponds to the upper critical magnetic field intensity for superconducting transition, its temperature dependence has been calculated for both superconducting transitions. Author

N88-21779# Joint Publications Research Service, Arlington, Va.
PROPERTIES OF SUPERCONDUCTORS WITH STRONG ELECTRON-PHONON INTERACTION Abstract Only **c76**
L. N. Bulayevskiy and O. V. Dolgov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 28 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 413-415 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

The properties of superconducting materials anomalously departing from the Bardeen Cooper Schrieffer model, namely of Ba(Pb(1-x)Bi(x))O3 compounds and various organic compounds such as gbH-(BEDT-TTF)2I3 or gb-(BEDT-TTF)AuI2, are calculated on the basis of the Eliashberg model with a single phonon mode and a large coupling coefficient gl1 characterizing strong electron-phonon interaction. The superconducting transition temperatures and the upper critical magnetic field intensity are accordingly calculated from the corresponding equations of this model as functions of this coupling coefficient, with only the orbital field effect considered and with Coulomb repulsion ignored. In addition, the temperature dependence of the upper critical magnetic field intensity is also determined. From the Ginzburg-Landau free-energy functional for the case of a uniform order parameter the dependence of the electron states density at near zero temperature on the jump of specific heat, on both upper and lower critical magnetic field intensities, and on the residual electrical resistivity of a dirty superconductor is then obtained. Author

N88-21780# Joint Publications Research Service, Arlington, Va.
ROTATION OF UNIVERSE Abstract Only **c90**
D. D. Ivanenko and V. G. Krechet *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 30 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy:Fiziki (Tomsk, USSR), v. 30, no. 3, Mar. 1986 p 12-16 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

Rotation of the Universe is considered, this possibility being indicated by the anisotrophy of radio emission by many cosmic sources. In accordance with the concept of a hierarchically structured physical reality and by methods of the General Theory of Relativity for gravitation, analytical expressions are derived for the angular momentum of the three principal objects in this hierarchy: maximon - hadron - Metagalaxy. Formal description of the geometrical configuration of current lines of a continuous medium in the Einstein-Cartan space leads to the Raychauduri equation in the Reimannian space and to twist of the space-time continuum in the form of a pseudotrace as the likely cause of rotation, the cosmological model with twist being the source of rotation in the Godel model. Extension of the stationary metric to a nonstationary space with rotation and with twist yields a relation of the Regge kind for the spin of a Metagalaxy which also applies to elementary particles. Further calculations are therefore made using the ratio of Universe mass to proton mass and the Dirac concept of large numbers, as well as estimates according to Markov, Recami, Salam, and Stanyukovich. Author

N88-21781# National Science Foundation, Washington, D.C.
UNITED STATES - JAPAN SEMINAR ON QUANTUM MECHANICAL ASPECTS OF QUANTUM ELECTRONICS
Jeffrey H. Shapiro and Hiroshi Takuma 1987 663 p Seminar held in Monterey, Calif., 21-24 Jul. 1987 Prepared in cooperation with ONR, Washington, D.C. and Japan Society for the Promotion of Science, Tokyo
(AD-A186938) Avail: NTIS HC A99/MF A01 CSCL 20C

Topics addressed include: neutral atom trapping; ultrahigh stability sources and ultrahigh resolution spectroscopy; squeezed states of light; and nonlinear optics of semiconductors. For individual titles, see N88-21782 through N88-21812.

N88-21782# National Bureau of Standards, Gaithersburg, Md.
OPTICAL COOLING AND TRAPPING **c72**
William D. Phillips *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 13-35 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The principles of laser cooling, deceleration of an atomic beam, the effect on an atomic beam velocity distribution when nothing is done to compensate the changing Doppler shift, and consideration of dipole forces on atoms in laser fields are discussed. This presentation is represented by viewgraphs only. B.G.

N88-21783# Bell Telephone Labs., Inc., Holmdel, N. J.
OPTICAL TRAPPING OF NEUTRAL ATOMS AND DIELECTRIC PARTICLES BY RADIATION PRESSURE **c72**
A. Ashkin, J. E. Bjorkholm, and S. Chu *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 36-69 (For primary

document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Recently a number of exciting results were achieved in the field of laser trapping and manipulation of small dielectric particles. Optical trapping and manipulation of Na atoms was demonstrated at record low temperatures and densities. Trapping of submicron Rayleigh particles with diameters down to approximately 250 A was achieved. Individual biological particles such as viruses, bacteria, and small organisms were also manipulated with light. The basic forces involved in trapping all these rather diverse particles are the forces of radiation pressure which come from the momentum of the light itself. The history of the subject is traced, some physical feel for the subject is given, some of the principal results are mentioned, and the perspective on the future given. This presentation is represented by viewgraphs only.
Author

N88-21784# Essen Univ. (West Germany).
MACROSCOPIC QUANTUM JUMPS IN A SINGLE ATOM c72
Axel Schenzie and Richard G. Brewer (International Business Machines Corp., San Jose, Calif.) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 70-89 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

A single atom optical clock proposed over ten years ago utilizes an amplification scheme which only recently was recognized as a problem in quantum statistics. The atom, a three state system, has two coupled transitions that are driven continuously by two external fields, one being an allowed transition and the other a forbidden transition. It was argued that the weak transition, which is difficult to detect, could be monitored by the presence or absence of spontaneous emission of the strong transition. Thus, when the atom is shelved in the metastable state, the strong transition is extinguished, but when the atom executes a single quantum jump, it triggers a succession of perhaps a million quantum jumps in the strong transition, an amplification that can be detected easily. This intuitive argument for alternating bright and dark intervals assumes, however, that the atom is always in an eigenstate. Should the atom be in a superposition state, because of coherent excitation, it could be imaged that the weak transition would merely reduce the intensity of the strong transition slightly. This issue is resolved by calculating the photon counting statistics, the probability W(n,T) of observing precisely n photon counting events in a collection T in a quantum mechanically consistent way. The results cannot be described by classical statistics. A compact analytic form was obtained for W(n,T). This presentation is represented by viewgraphs and abstracts only.
Author

N88-21785# Tokyo Univ. (Japan).
LASER COOLING OF NEON METASTABLE STATES c72
Fujio Shimizu, Kazuko Shimizu, and Hiroshi Takuma (University of Electro-Communications, Tokyo, Japan) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 90-103 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The first demonstration of the layer cooling of a neutral atomic beam other than alkali atoms is reported. A neon beam was cooled using the 640 nm transition between the metastable state 1s5 (J=2) and 2pg (J=3). These cooled 1s5 metastable atoms were transferred to another metastable state 1s3 (J=0). The population in 2pg can decay only to the metastable state 1s5. Therefore, these metastable atoms can be cooled by the same technique used for the cooling of alkali beams. The experimental setup is basically the same as the sodium cooling by Phillips. The metastable atoms are created by a dc discharge, and are extracted through a pinhole on the anode. The deceleration laser with 640 nm is sent from the opposite direction towards the Ne beam source. It is usually circularly polarized. To transfer the cooled 1s5 atoms to the 1s3 level, a 586 nm laser is crossed perpendicular to the Ne beam approximately 1 cm upstream of the Doppler analysis point. The results show that a large fraction of the 1s5 atoms can be slowed 100 m/s suitable for the further deceleration and trapping by standing wave lasers or by magnetic fields. Neon atoms in the beam are expected in either 1s5, 1s3, or ground states. It is also possible to produce pure 1s3 or ground state atoms from 1s5 atoms by various laser pumping schemes. Therefore, by combining the cooling technique, cooled atoms in single metastable or ground state can be produced. This presentation is represented by viewgraphs only.
Author

N88-21786# Tokyo Univ. (Japan). Dept. of Applied Physics.
GIGANTIC OPTICAL NONLINEARITY IN LOW DIMENSIONAL SYSTEMS c76
Eiichi Hanamura *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 104-116 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Artificial as well as natural low-dimensional materials are now available in addition to bulk crystals. The material system with larger nonlinear optical susceptibility is being looked for to realize a more effective optical information processor. First, the dimensional effects on chi (sup 3) are discussed and how chi (sup 3) increases when the bulk system of 3-dimension is proceeded into 2- and 1-dimensional systems. Here the larger chi (sup 3) comes from the enhanced oscillator strengths due to the stronger confinements of particles and the stronger exciton effect in lower dimensional systems. Second, the nonlinear optical susceptibility is shown to be extremely enhanced for an assembly of microcrystallites as 0-dimensional systems. This is because the exciton is quantized due to the confinement effect and the excitons in a single microcrystallite interact strongly enough to make the excitons deviate from ideal harmonic oscillators. This presentation is represented by viewgraphs only.
Author

N88-21787# University of Southern California, Los Angeles. Center for Laser Studies.
MEASUREMENTS OF OPTICAL NONLINEARITIES IN MOCVD-GROWN GaAs/GaAlAs MULTIPLE QUANTUM WELLS c76
E. Garmire *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 117-127 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Measurements on nonlinear absorption made by A. Kost and M. Kawase in material provided by H. C. Lee, A. Hariz, and P. D. Dapkus are presented. Five samples with differing well thicknesses were compared. By fitting the measurements of saturable absorption at particular wavelengths to excitonic bleaching (at low intensity levels) and background absorption saturation (at high intensity levels), the separate contributions to the absorption are inferred. The well dependence of the height of the absorption contributions and also the saturation intensities were measured. From measurements of the wavelength dependence of the saturable absorption, calculations were made of the wavelength dependence of the change in refractive index. The dependence of the change in index with intensity on or near resonance is sublinear. This presentation is represented by charts and tables only.
Author

N88-21788# Tokyo Univ. (Japan).
DYNAMIC AND SPECTRAL PROPERTIES OF SEMICONDUCTOR LASERS WITH QUANTUM WELL, QUANTUM WIRE, AND QUANTUM BOX STRUCTURES c36
Yasuhiko Arakawa *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 147-182 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Dynamic and spectral properties of semiconductor lasers having quantum-mechanical microstructures are discussed with emphasis on the quantum box lasers. The theoretical analysis indicates that laser characteristics are significantly improved in low-dimensional

electronic gas systems. In order to demonstrate the quantum box effects experimentally, a quantum well laser was placed in a high magnetic field, in which zero-dimensional electronic systems are formed by both Lorentz force and the quantum well potential effects. In addition, recent progress of picosecond pulse generation in quantum well lasers is also discussed. This presentation is represented by viewgraphs only. Author

N88-21789# Tokyo Inst. of Tech., Yokahama (Japan).
ULTRAHIGH COHERENT SEMICONDUCTOR LASERS AND THEIR APPLICATIONS TO Rb ATOMIC CLOCK **c36**
M. Ohtsu, K. Kuboki, and M. Hashimoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 183-215 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

It was demonstrated that the FM noise in semiconductor lasers can be reduced to a value lower than the quantum noise limit by using negative electrical feedback. A synthesized method of electrical feedback is proposed to realize such ultrahigh temporal coherence in semiconductor lasers. As an alternative scheme to realize such ultrahigh coherence in semiconductor lasers, an experimental method for accurate frequency tracking using the correlated spontaneous emission between the two longitudinal modes was presented. A method of resonant coupling between the two optical transitions are employed via optical sidebands produced by parametric modulation of the laser gain. By this modulation, the linewidth of the heterodyned signal was reduced to 25 kHz. The value corresponds to suppression of the relative phase noise to less than one-twentieth of the quantum noise limit of the free-running laser. As an application of these ultrahigh coherent lasers, the lasers were used as optical pumping sources for Rb atomic clock of 6.8 GHz frequency. An optical microwave double resonance spectral shape with the linewidth as narrow as 20 Hz is demonstrated by utilizing FM sidebands of the laser induced by nonlinear susceptibility of the three-level Rb atoms. This presentation is represented by viewgraphs only. Author

N88-21790# Keio Univ., Yokahama (Japan). Dept. of Physics.
SQUEEZED STATE IN DEGENERATE PARAMETRIC AMPLIFICATION DISCUSSED BY H. TAKAHASI IN 1963 **c76**
Koichi Shimoda *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 216-234 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

A theory of quantum noise was developed by Professor Hidetosi Takahasi by appropriately applying the quantum mechanics to a general theory of communication channels. The quantum-mechanical coherent state of a harmonic oscillator is discussed, and a quantum theory of parametric amplifiers, in which the squeezed state in degenerate parametric conversion was particularly emphasized, was subsequently developed. This presentation is represented by viewgraphs only. Author

N88-21791# Texas Univ., Austin. Dept. of Physics.
SQUEEZED STATES OF LIGHT Abstract Only **c74**
H. J. Kimble, R. J. Brecha, L. A. Orozco, M. G. Raizen, L. A. Wu, and M. Xiao *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 235-236 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

In the laboratory squeezed states of light were generated in two distinct physical systems. The first experiment investigates squeezing for two level atoms coupled to the intracavity field of a high quality optical resonator. For large coupling of the atoms to the cavity field, there is a mode splitting in the eigenvalue structure of the system analogous to the splitting found when two otherwise independent pendulums are coupled by a spring. The coupling-induced structure of the composite system was employed to generate squeezing. The second experiment involves the process of degenerate parametric down conversion in which a photon of frequency 2 omega is split into a correlated pair of photons at the subharmonic frequency omega. While noise reductions of greater than 60 percent were observed relative to the vacuum-state limit, a quantitative analysis of the various propagation and detection losses in the current apparatus indicates that the field would in fact be squeezed more than ten-fold in the absence of these losses. Quite recently use was made of the squeezed light to demonstrate that precision measurements can be made with a sensitivity greater than that given by the vacuum-state or shot-noise limit. This presentation is represented by abstracts only. Author

N88-21792# Bell Telephone Labs., Inc., Murray Hill, N. J.
PULSED SQUEEZED LIGHT **c74**
R. E. Slusher *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 237-252 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Generation of interesting quantum states of light, including squeezed states and number states, requires a large nonlinear interaction. An extension of standard generation and homodyne detection experimental techniques to the pulsed case is described. It is expected that by using mode-locked pulse trains as the pump laser and a portion of the pulse train as the local oscillator for the homodyne detector that corresponds to generation by the peak laser pump intensity in the pulse train. Viewgraphs 3 through 6 describe the analysis of pulsed squeezing. Viewgraphs 7 and 8 describe a pulsed LO homodyne detector which is working at present. This presentation is represented by viewgraphs. Author

N88-21793# International Business Machines Corp., San Jose, Calif.
QUANTUM NONDEMOLITION DETECTION AND SQUEEZING IN OPTICAL FIBERS **c74**
M. D. Levenson, R. M. Shelby, and S. H. Perimutter *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 253-267 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The nonlinear optical interactions in an optical fiber permit the amplitude of one wave to be inferred from the phase of a coupled wave, and the partial suppression of quantum noise. This process was termed Quantum Nondemolition Detection (QND) or Back Action Evading Measurement. The QND readout was correlated with a subsequent quantum demotion detection (QDD) measurement of the QND variable. Back action evasion was demonstrated by showing that the QND variable at the output of the detector has no greater noise than at the input (which was at the vacuum noise level). When the correlated noise on two coupled laser beams is made to subtract coherently, the net noise level can be below the vacuum noise level. This effect was termed four-mode squeezing since the fluctuations involve two sidebands of each of two strong pump waves. This presentation is represented by viewgraphs only. Author

N88-21794# Hiroshima Univ. (Japan). Dept. of Physical Electronics.
OPTICAL PROPERTIES OF QUANTUM WELL STRUCTURES WITH ELECTRIC FIELD: LIFE TIME FREE SWITCHING OF LUMINESCENCE INTENSITY AND VIRTUAL CHARGE-INDUCED ULTRAFAST OPTICAL NONLINEARITY **c76**
Masamichi Yamanishi *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 268-303 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Modulation schemes for luminescence intensity and for attaining an ultrafast optical nonlinearity are discussed, pointing out possibilities of field controlled light emitters and of ultrafast control of quantum states. This presentation is represented by viewgraphs only. Author

N88-21795# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan).
ENHANCED EXCITONIC OPTICAL NONLINEARITY AND EXCITON DYNAMICS IN SEMICONDUCTOR MICROSTRUCTURES **c76**
T. Takagahara *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 321-326 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The mechanisms of enhanced excitonic optical nonlinearity in semiconductor microstructure are clarified to be the easily attainable state filling of discretized levels due to the quantum size effect and the enhanced oscillator strength. The calculated third-order nonlinear susceptibility explains successfully the recent experimental results. A comprehensive interpretation of the exciton dynamics in semiconductor microcrystallites is presented to explain the fast and slow decay components in phase conjugation and luminescence measurements. Author

N88-21796# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
FREE CARRIER NONLINEAR OPTICS **c74**
P. A. Wolff *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 327-343 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Free carriers in semiconductors cause optical nonlinearity in two ways. In some cases it arises from the inherent nonlinearity of electron dynamics in crystals; in others it is caused by scattering. Until lately, all known free-carrier-induced optical nonlinearities were weak. Two crystals, HgTe and HgCdSe:Fe, in which large, fast, free-carrier-induced chi (sup 3) may be attainable, were investigated. These materials will be used as examples to illustrate the mechanisms and features of free-carrier-induced optical nonlinearity. The nonlinear susceptibilities were measured by four wave mixing experiments performed with a pair of Q-switched CO2 lasers. The absence of saturation is striking. The optical nonlinearity was attributed to the interband population modulation between the heavy mass valence band and the light mass conduction band. This presentation is represented by viewgraphs only. Author

N88-21797# California Univ., Berkeley.
BERRY'S PHASE IN FIBER OPTICS **c74**
R. Y. Chiao *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 344-363 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Berry discovered in quantum mechanics a topological phase factor similar to the Aharonov-Bohm phase factor. This phase is acquired by a system when it is adiabatically transported around a closed circuit in the parameter space of the Hamiltonian. Several experiments have now confirmed the existence of this phase. An optical experiment which observed a manifestation of Berry's phase as a topological optical activity in a helical optical fiber is presented. The wavelength-independence of this optical activity was also verified. Recently, this phase was generalized to nonadiabatic evolutions by Aharonov and Anandan. Another optical experiment to observe this nonadiabatic phase is examined. Possible applications, e.g., to gyroscopes, will be discussed. This presentation is represented by viewgraphs only. Author

N88-21798# Bell Telephone Labs., Inc., Holmdel, N. J.
HIGH DENSITY FEMTOSECOND EXCITATION OF NONTHERMAL CARRIER DISTRIBUTIONS IN INTRINSIC AND MODULATION DOPED GaAs QUANTUM WELLS **c76**
Wayne H. Knox, Daniel S. Chemla, and Gabriela Livescu *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 364-376 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The dynamics of nonthermal carrier distributions in undoped and modulation doped GaAs Quantum Well Structures (layer thickness is approximately 100 A) with near bandgap-resonant intense femtosecond light pulses. The carrier-carrier scattering process was studied up to very high energies and the first optical investigation of nonthermal carrier generation in the presence of a thermalized Fermi-sea of electrons was performed. In undoped quantum wells a reduction of the thermalization time was found from about 100 fs to about 30 fs as the photocarrier density increases from N sub eh is approximately 3 x 10 to the 10th/sq cm to approximately 10 to the 12th/sq cm. The thermalization time is found to be sensitive to background doping with excess electrons in modulation doped samples. Author

N88-21799# Tsukuba Univ., Ibaraki (Japan). Inst. of Physics.
DYNAMICAL ASPECTS OF CARRIER TUNNELING IN SEMICONDUCTOR SUPERLATTICES **c76**
Yasuaki Masumoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 377-394 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Dynamical carrier processes in GaAs-AlGaAs superlattices are studied by means of picosecond spectroscopy and population mixing technique under the electric field along the superlattice direction. Two prominent structures are found in the curves of exciton luminescence and photocurrent vs. the electric field. They are ascrived to the onset of exciton dissociation followed by electron tunneling through AlGaAs barriers and resonant electron sequential tunneling. The electron tunnel rate is determined to be 1/(430 ps) and is compared with calculations. In addition, competitive nature of ultrafast processes of photo-excited electron-hole pairs, exciton formation, and pair ionization followed by tunneling through barriers, are clarified under the various electric fields. Author

N88-21800# Arizona Univ., Tucson. Optical Sciences Center.
EXPERIMENTAL AND THEORETICAL STUDIES OF COHERENT AND NONTHERMAL PROCESSES IN SEMICONDUCTORS PROBED BY FEMTOSECOND LASER TECHNIQUES **c76**
N. Peyghambarian and S. W. Koch *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 396-414 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The coherent interaction of femtosecond laser pulses and a thin CdSe sample is investigated both experimentally and theoretically. Observation of coherent phenomena in semiconductors is very rare because the incoherent processes occur in the femtosecond time domain in these materials. One example of such a phenomena is the so called optical Stark effect of exciton where a blue shift of the exciton resonance occurs as a result of pumping below the bandgap. The coherent effects involving band-to-band and also exciton transitions. Using femtosecond transmission measurements clear evidence was observed for coherent interference effects of the light field and the driven material polarization. These interferences manifest themselves as oscillatory structures in the differential transmission spectra. The oscillatory features are explained by comparison with a semiclassical theory. Examples of the computed results are presented for different time delays between probe and pump. To analyze the situation where the transmission spectra are measured in the vicinity of the exciton, the exciton is a single homogeneously broadened transition. Author

N88-21801# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
FEMTOSECOND STUDIES IN HOT CARRIER RELAXATION IN GaAs AND AlGaAs **c76**
E. P. Ippen and J. G. Fujimoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of

Quantum Electronics 1987 p 415-433 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Femtosecond carrier dynamics in GaAs and AlGaAs thin films were studied by femtosecond pump-probe absorption saturation spectroscopy. Identical pulse measurements monitor the rapid scattering of the carriers out of their initial, optically excited states. Multi-wavelength continuum probe investigations confirm the presence of the initial nonthermal carrier distribution as well as the appearance of state-filling throughout the band on a timescale of tens of femtoseconds. This presentation is represented by viewgraphs. Author

N88-21802# Yamaguchi Univ. (Japan). Dept. of Physics.
EXCITON RELAXATION PHENOMENA IN A DISORDERED SYSTEM **c76**
Masaki Aihara *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 434-437 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Exciton relaxation phenomena in a disordered system are theoretically investigated by transient resonant light scattering and the transient optical parametric effect. For transient resonant scattering, the following observations are made. In the case of weak disorder, the fast scattering-like and the slow luminescence-like components distinctly arise in the time-resolved spectrum of resonantly scattered radiation. In the case of strong disorder, the scattering-like rapid component and the luminescence-like slow components are amalgamated. In the case of a very strong disorder with the split spectrum, the quantum beat effect inherent in the excitons in mixed crystals arises. For the transient optical parametric effect, a significant deviation from the exponential decay is found even in the case of the relatively weak disorder. Author

N88-21803# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan).
GENERATION OF NUMBER-PHASE MINIMUM UNCERTAINTY STATES **c76**
Y. Yamamoto, S. Machida, N. Imoto, M. Kitagawa, and G. Bjoerk *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 438-450 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The difference between the two nonclassical lights, i.e., the squeezed state and number-phase minimum uncertainty state (NUS) is discussed. The four different generation principles for NUS are described. They are: unitary evolution using self-phase modulation; nonunitary state reduction by the first kind measurement; controlled state reduction by quantum correlation measurement-feedback, and high saturated laser oscillation with suppressed-pump-noise. The constant current-driven semiconductor laser based on the last principle generated the NUS with photon number noise reduced below the standard quantum limit by 40 percent in the entire frequency region from dc to 1.1 GHz. Several applications of NUS including quantum communication, quantum mechanical computers and interferometric gravitational detection are discussed briefly. This presentation is represented by viewgraphs only. Author

N88-21804# Northwestern Univ., Evanston, Ill.
SQUEEZING VIA TRAVELLING-WAVE FORWARD FOUR-WAVE MIXING IN ATOMIC VAPORS: COMPARISON WITH NONDEGENERATE THEORY **c76**
Prem Kumar *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 451-475 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Recent observations of 4 percent squeezing via travelling-wave forward four-wave mixing in sodium vapor are in good agreement with the quantum theory of nondegenerate multiwave mixing. Squeezing spectra for the parameter values employed in the Maeda experiment are presented. It is shown that for the available dye-laser power, as much as a factor of four squeezing should be achievable from about 50 to 700 MHz in the sodium vapor experiment. However, Doppler broadening, optical pumping, and self-focusing effects may limit the observable squeezing. Author

N88-21805# Bell Telephone Labs., Inc., Murray Hill, N. J.
GENERATING SQUEEZED MICROWAVE RADIATION WITH A JOSEPHSON PARAMETRIC AMPLIFIER **c32**
B. Yurke *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 476-488 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

In an effort to generate squeezed microwave radiation at 20 GHz via a Josephson parametric amplifier, a factor of 2 squeezing of 4.2 K thermal noise was recently demonstrated. A room temperature mixer with a 660 K noise temperature was employed for homodyne detection. The overall detector system noise temperature (including waveguide losses) was 2100 K. In order to rule out detector saturation effects, a probe signal was injected into the mixer to monitor the detector system gain. Since at 4.2 K one is only an order of magnitude from the quantum noise floor, it is hoped that quantum noise squeezing will be observed when the device is cooled well below .5 K. This presentation is represented by viewgraphs. Author

N88-21806# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
DETECTING SQUEEZED STATES BY CROSS-CORRELATION **c76**
Z. Y. Ou, C. K. Hong, and L. Mandel *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 489-502 Sponsored in part by NSF and by ONR Submitted for publication (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

It is shown that squeezed states can be detected by cross-correlation measurements of the outputs of two detectors in a homodyne experiment, and that squeezing shows up as a positive correlation. The technique offers some of the same advantages as the balanced homodyne technique of Yuen and Chan, without the need to balance the detectors. This presentation is represented by viewgraphs. Author

N88-21807# University of Electro-Communications, Tokyo (Japan). Dept. of Engineering Physics.
WHAT HAS BEEN DONE AND WHAT WILL BE DONE BY SUBNATURAL LINEWIDTH SPECTROSCOPY **c25**
Hiroshi Takuma, Kazuko Shimizu, and Fujio Shimizu (Tokyo Univ., Japan) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 503-530 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

Reduction of linewidth is an essential approach in high resolution spectroscopy. Several methods to remove or reduce inhomogeneous linewidth were developed resulting in a drastic improvement in the high resolution capability of laser spectroscopy. On the other hand, application of lasers was not very effective in reducing homogeneous linewidth. Main causes of the homogeneous line broadening in gaseous media are pressure broadening, saturation broadening, limited interaction time (transit time in the atomic/molecular beam spectroscopy), and natural width. Among those, the first and second ones are easily removed or reduced. The third one can be reduced by the use of recently developed laser cooling techniques. Thus the present discussion will be concentrating on the last one: reduction of the natural linewidth. This presentation is representated by viewgraphs. Author

N88-21808# Tokyo Univ. (Japan). Dept. of Physics.
COMPREHENSIVE MODEL FOR LASER INSTABILITY IN A CO2 LASER WITH GASEOUS SATURABLE ABSORBER c36
Tadao Shimizu, Maki Tachikawa, and Kazuhito Tanii *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 531-551 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

A periodic self-pulsation well known as passive Q-switching (PQS) is observed in a CO2 laser containing a gaseous saturable absorber inside its cavity. The PQS was developed as a high power pulse source to pump far-infrared lasers. In response to the recent interest in laser instability, it is now being investigated extensively. Dynamic properties of the relating molecular systems are sensitively reflected in the transient pulse structure, and various features of PQS pulsation are realized, depending on lasing conditions and characteristics of the absorbing molecules. So far, inspite of extensive efforts to analyze the PQS behavior, there is no good model which reproduces the observed pulse structure with fidelity. Through the numerical integration of the rate equations systematic reproduction of all the PQS pulses, especially the PQS pulse with the undamped undulation was accomplished. The undulation was revealed as a relaxation oscillation induced by the relaxation of the lower laser level. The model also describes optical bistability observed in the present laser system. The computer calculation based on the present model shows that chaotic pulsation is realized led by the period-doubling route. This is the first demonstration of chaos in a laser containing a saturable absorber. The present analysis suggests that it is possible by introducing saturable absorbers inside the cavity to observe chaos even in small-gain lasers such as CO2 and N2O lasers far from the bad-cavity condition. This presentation is represented by viewgraphs. Author

N88-21809# Kyoto Univ. (Japan). Dept. of Physics.
RECENT PROGRESS IN OPTICAL BISTABILITY AND TRISTABILITY c74
T. Yabuzaki and M. Kitano *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 552-574 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

In recent years optical bistability and tristability were studied theoretically and experimentally, and related phenomena such as self-pulsing, chaos, and transient chaos. The focus is on optical bistability, which is caused by the spin polarization in the presence of optical feedback. This bistability is considerably different from the ordinary one, because it has no hysteresis cycle, while it does have a pitchfork bifurcation, i.e., symmetry-breaking. The self-switching of the light polarization by spin-procession, which takes place in the same optical system is discussed. Finally, the multistability observed experimentally is discussed using simplified models with coupling between spatial nodes of light. This presentation is represented by viewgraphs. Author

N88-21810# Northwestern Univ., Evanston, Ill. Dept. of Electrical Engineering and Computer Science.
NONCLASSICAL LIGHTS c74
Horace P. Yuen *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 575-600 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The differences between nonclassical lights and coherent-state lights are reviewed. Some general observations are made concerning the generation, propagation, and detection of squeezed-state and near number-state lights. The role of phase-sensitive linear amplifiers and photo-number amplifiers is emphasized. Certain possible applications of nonclassical lights to communications are described, including optic nerve local area networks. This presentation is represented by viewgraphs. Author

N88-21811# Waikato Univ., Hamilton (New Zealand). Dept. of Physics.
QUANTUM STATISTICS OF PARAMETRIC OSCILLATORS ABOVE THRESHOLD c77
D. F. Walls, M. J. Collett, A. S. Lane, M. D. Reid, and C. M. Savage (Arizona Univ., Tucson.) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 601-627 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The quantum statistics of the degenerate parametric oscillator above threshold are described. The squeezing spectrum is plotted for a range of parameters. The nondegenerate parametric oscillator is studied above threshold where the solutions are known to undergo phase diffusion. The fluctuations in the difference current from the signal and idler modes are calculated for the case where the signal and idler have different cavity decay rates. This presentation is represented by viewgraphs. Author

N88-21812# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
OPEN QUESTIONS IN CLOSED-LOOP PHOTODETECTION c77
Jeffrey H. Shapiro *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 628-660 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

The usual open-loop quantum and semiclassical theories of light detection apply to configurations in which there is no feedback from the photodetector to the light bean impinging on that detector. In these circumstances there are unmistakable signatures of nonclassical light, such as sub-shot-noise spectra and sub-Poisson photocounts. No such unmistakable signatures exist for the case of closed-loop photodetection, i.e., for configurations in which there is a feedback path from the detector to the light source. Recent progress in the theory of closed-loop photodetection is reviwed, and possible future schemes for quantum-state synthesis and quantum-measurement synthesis are extrapolated. This presentation is represented by viewgraphs. Author

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-21813*# National Aeronautics and Space Administration, Washington, D.C.
METHOD FOR DETERMINING ARTILLERY POSITION
Johannes Fischer, Werner Loges, and Wilfried Meuser Apr. 1988 21 p Transl. into ENGLISH of German Patent no. DE-3239403-A1 (26 Apr. 1984) Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20236; NAS 1.77:20236) Avail: NTIS HC A03/MF A01 CSCL 20A

A method is disclosed for determining the position of cannon from measurement sites whose distance from each other lies in the same order of magnitude as the distance between the cannons – that distance being in the kilometer range – with the help of the travel time evaluation of muzzle blasts received at the measurement sites. There are at least two measurement sites, consisting of a cruciform of four microphones each positioned so that one axis is oriented to an arbitrarily chosen reference direction with the microphones spaced closely together. In this arrangement of diametrically opposed microphones, the respective travel times are determined and placed in a relationship whose arctangent is a radio bearing to the reference direction in which radio bearings are determined with consideration of their position and their opposing distance from the cannon position. Author

N88-21364# Joint Publications Research Service, Arlington, Va.
NONLINEAR ACOUSTIC PARAMETER AND ITS APPLICATION IN ULTRASONIC IMAGING Abstract Only
Zuwen Qian *In its* JPRS Report: Science and Technology. China 29 Oct. 1987 p 45 Transl. into ENGLISH from Yingyong Shengxue (Beijing, Peoples Republic of China), v. 6, no. 3, Jul. 1987 p 1-7 (For primary document see N88-21350 14-31)
Avail: NTIS HC A06/MF A01

N88-21752# Joint Publications Research Service, Arlington, Va.
ADDITIONAL PEAK OF LIGHT SCATTERING BY SOUND UNDER CONDITIONS OF ACOUSTIC INSTABILITY Abstract Only
D. V. Kagan and A. F. Ioffe *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 1 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, Apr. 1987 p 1199-1202 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-21814# California Univ., Berkeley. Dept. of Chemistry.
CROSSED MOLECULAR BEAM STUDIES OF SUBSTITUTION AND EXCHANGE REACTIONS Ph.D. Thesis
G. N. Robinson Dec. 1987 206 p Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab.
(Contract DE-AC03-76SF-00098)
(DE88-006322; LBL-24635) Avail: NTIS HC A10/MF A01

Atom + alkene/aromatic and radical + iodoalkane reactions were studied. F + C2H4 yields (C2H4F)* yields H + C2H3F was studied at low collision energies. The substitution cross section decreases with increasing E sub c, suggesting that long-range attractive forces dominate the F-C2H4 interaction. The CM frame C2H3F angular distributions may reflect unusual angular momentum partitioning in the C2H4F collision complex. Chapters 2 and 3 describe studies of endoergic substitution reactions, Br + R-Cl yields R-Br + Cl, where R-Cl = 0-, m-, and p-CH3C6H4Cl, C6X5Cl (X = H, F), and 1,1- and trans-C2H2Cl2 in the collision energy range 15 to 35 kcal/mol. Br adds to the double bond to form a weakly bound collision complex which then decomposes through Cl elimination. Competition between intramolecuar vibrational modes and Cl elimination results in translational energy distributions and excitation functions that can be modeled by a limited number of vibrational modes participating in energy sharing prior to bond fission. Substituents influence the orientation and probability of Br addition as well as energy redistribution. The first crossed beam studies of CH3 radicals with polyatomic molecules are reported in Chapter 4. The CH3I products from the reactions CH3 + R-I yields CH3I + R (R = CF3, (CH3)3C) are strongly backward scattered, indicating a preferred collinear CH3-I-R configuration. Most of the 15 kcal/mol of available energy is channeled into product translation (50 percent for R = (CH3)3C and 70 percent for R = CF3). This large repulsive energy release is rationalized in terms of stability of the CH3-I-R transition structures. DOE

N88-21815# Netherlands Energy Research Foundation, Petten.
SYSTEMATICS ON NEUTRON-INDUCED ISOMERIC CROSS-SECTION RATIOS AT 14.5 MeV
J. Kopecky and H. Gruppelaar Aug. 1987 36 p Sponsored by the Joint Research Centre of the European Communities, Ispra, Italy
(ECN-200; B8727800; ETN-88-91717) Avail: NTIS HC A03/MF A01

The status of knowledge on branching ratios of isomeric and ground-state cross-sections at 14 to 15 MeV is reviewed. Earlier systematics for the isomer ratios of the (n,n'), (n,p), (n,t), (n,alpha) and (n,2n) reactions are examined and new systematics for these reactions are presented. A comparison with model calculations is discussed. The (n,2n) isomer ratios show a behavior different from that of the studied one-step reactions. A table with experimental information on (n,2n) cross-section data at 14 to 15 MeV is included. ESA

N88-21816 Vrije Universiteit, Amsterdam (Netherlands).
GROUND-STATE CORRELATIONS IN C12 AND THE MECHANISM OF THE (e,e'p) REACTION Ph.D. Thesis
Gerardus vanderSteenhoven 1987 154 p
(B8729349; ISBN-9-09-001912-X; ETN-88-91840) Copyright
Avail: Vrije Universiteit te Amsterdam, 100 MC Am sterdam, Netherlands

The mechanism of the quasi-elastic (e,e'p) reaction was studied to use the results in the extraction of nuclear-structure information from (e,e'p) measurements on C12. Two aspects of the (e,e'p) reaction: the interaction between the incident electron and the bound proton (e-p coupling); and the interaction between the outgoing proton and the residual nucleus (final-state interaction) were studied. Experimental information on the e-p coupling was obtained by carrying out the same (e,e'p) measurement at two values of the incident electron energy. It was demonstrated that the channel coupling (CC) effects in (e,e'p) are different from the CC-effects in elastic proton scattering. Employing the knowledge acquired on the electron-proton interaction and the final-state interaction, the momentum distributions corresponding to the 3/2 (-) ground state, the 1/2 (-) state at 2.215 MeV, and the 3/2 (-) state at 5.020 MeV in B11 were analyzed. The extracted spectroscopic factors exhaust only 57 + or - 7 percent of the 1p-sum rule. The low spectroscopic factors might be due to strong NN-correlations causing a depletion of valence orbitals. ESA

N88-21817# Rome Univ. (Italy). Dipt. di Fisica.
NEW LIMITS ON CHARGED HIGGS BOSON MASS WITH CELLO AT PETRA (ITALY) AND STATUS OF THE NEUTRAL HIGGS BOSON SEARCH
G. DAgostini 9 Oct. 1987 11 p Presented at the San Miniato 2nd Tropical Seminar on Heavy Flavors, San Miniato, Italy, May 1987
(Nota-Interna-897; ETN-88-92252) Avail: NTIS HC A03/MF A01

A search was performed for charged Higgs bosons in e (+) e (-) annihilation at center of mass energies up to 46.8 GeV. From absence of both hadronic and leptonic signatures, they are excluded up to a mass of 19 GeV/cu sq, independently of the hadronic and leptonic branching ratios. The situation of the neutral Higgs search is reviewed. Only some ranges in its mass spectrum are excluded, so that its search is interesting both at low and high energy. ESA

N88-21818# Rome Univ. (Italy). Dipt. di Fisica.
SUMMARY OF SUPERSYMMETRIC PARTICLE SEARCH WITH THE CELLO DETECTOR AT PETRA (ITALY)
G. DAgostini 9 Oct. 1987 11 p
(Nota-Interna-898; ETN-88-92253) Avail: NTIS HC A03/MF A01

Efforts to detect signals from phenomena coming from the predictions of supersymmetric theories are reviewed. The negative results of this wide search put limits for the mass of various supersymmetric particles: scalar partners of electrons, muons, taus and quark; photinos, winos and zinos. Although the Standard Model is sufficient to describe the experimental data, none of the limits represents a serious problem for the supersymmetric theories and the supersymmetric particle search remains of major interest in the next generation of accelerators. ESA

N88-21819# Rome Univ. (Italy). Dipt. di Fisica.
THE RESPONSE OF A SMALL LIQUID SCINTILLATION COUNTER FOR LOW ENERGY (GAMMA, p) EXPERIMENTS
S. Bernabei, S. dAngelo, M. P. DePascale, P. Picozza, P. Belli, A. Incicchetti, D. Prosperi, and B. Girolami (Istituto Superiore di Sanita, Rome, Italy) 30 Nov. 1987 16 p
(Nota-Interna-901; ETN-88-92255) Avail: NTIS HC A03/MF A01

Experimental details and the performance of a small NE213 counter operating at high pressure used in low energy (gamma, p) experiments are described. The p/gamma discrimination techniques, used to select a low event rate of protons in a high photon background, are described. ESA

N88-21820# Rome Univ. (Italy). Dipt. di Fisica.
MEASUREMENT OF THE SUP 4He(GAMMA, p)SUP 3H TOTAL CROSS SECTION AND CHARGE SYMMETRY
P. Belli, R. Bernabei (Auckland Univ., New Zealand), L. Casano, A. Chisholm, S. dAngelo, M. P. DePascale, B. Girolami, A. Incicchitti, P. Picozza, and D. Prosperi et al. 3 Dec. 1987 15 p
(Nota-Interna-902; ETN-88-92256) Avail: NTIS HC A03/MF A01

The absolute total cross section for the sup 4 He (gamma, p) sup 3 H reaction was measured in the gamma energy region between 28.6 and 58.1 MeV with a monochromatic photon beam and a nearly 4 pi proton detector. The comparison of results with other data provides a mean value of R gamma = sigma (gamma, P)/sigma (gamma, n) = 1.01 + or - 0.06 between 28.6 and 42.4 MeV and tends to exclude a strong isospin mixing in the sup 4 He due to charge symmetry breaking of the nuclear force. ESA

N88-21821# Rome Univ. (Italy). Dipt. di Fisica.
GLUINO BRANCHING RATIO EFFECTS ON THE SEARCH FOR SUPERSYMMETRY
G. Gamberini, G. F. Giudice, B. Mele (Istituto Nazionale di Fisica Nucleare, Rome, Italy), and G. Ridolfi 4 Nov. 1987 13 p
(Preprint-572; ETN-88-92262) Avail: NTIS HC A03/MF A01

It is shown that the effect of the gluino branching ratio for the decay gluino yields q q bar Chi, where Chi is the lightest supersymmetric particle, can sizeably reduce the sensitivity limits of the next generation of hadron colliders in the gluino search. However, gluino signals such as multilepton + multijet events can play an important role. In low energy supergravity models, it is not possible to give simply absolute limits on the gluino mass. On the contrary, the absence of any excess of missing pT events can be translated into constraints on the plane of the supersymmetric parameters. ESA

N88-21822# Rome Univ. (Italy). Dipt. di Fisica.
ANALYSIS OF HADRON PRODUCTION IN DEEP INELASTIC MUON-PROTON COLLISIONS THROUGH THE FIRE-STRING MODEL
E. Ferrari, G. Violini, G. Preparata, L. Angelini, L. Nitti, and M. Pellicoro (Bari Univ., Italy) 30 Nov. 1987 56 p Sponsored in part by the Italian Ministry of Public Education
(Preprint-578; ETN-88-92267) Avail: NTIS HC A04/MF A01

Experimental results on hadron production in deep-inelastic muon-proton collisions are analyzed in terms of the Fire-String model. Most features of the hadronic final states are satisfactorily accounted for. Discrepancies can be almost always traced back to a few well-defined phenomenological characteristics of the model, and give an indication about a possible improvement. In a few cases, the discrepancy between theory and experiment shows possible inconsistencies in the reported data, on the basis of general physical principles obeyed by the Fire-String model, but naturally found in any reasonable picture of strong interactions. ESA

N88-21823# Brookhaven National Lab., Upton, N. Y.
DETERMINATION OF BEAM ORIENTATION OF OPTICAL DIAGNOSTICS OF EXCITED 200-MeV HYDROGEN ATOMS RESULTING FROM PHOTODETACHMENT OF H(-)IONS Final Report, 1 Oct. 1985 - 1 Mar. 1987
A. Herschcovitch Sep. 1987 33 p
(AF Proj. 2301)
(AD-A189976; AFWL-TR-87-17) Avail: NTIS HC A03/MF A01 CSCL 14B

Nondestructive diagnostic techniques to determine beam direction of 200-MeV H atoms are analyzed. These methods are based on excited hydrogen atoms in n=2 and n=3 levels due to photodetachment of H(-) ions. An e-beam driven ArF laser can produce H*(2s) atoms for LRF by photoneutralizing H(-) ions in a quantity comparable to that of a gas cell if longer pulse hot cathode e-beam drivers are developed. Observation of fluorescence from spontaneous decay of H*(2p) or induced decay of H*(2s) can be readily used to indicate beam orientation with 40 microrad accuracy. Measurements of minute Doppler shifts of this Lyman-alpha radiation by a spectrograph could in principle resolve beam direction to within 2.8 microrad. For schemes requiring n=3 hydrogen atoms, an Xe laser can produce H*(3s) or H*(3p) atoms in quantities larger than any produced previously. GRA

N88-21272# Joint Publications Research Service, Arlington, Va.
AN INVESTIGATION OF THE INFRARED EMISSION SPECTRA OF CARBON CONDENSATES Abstract Only
V. Ye. Strelnitskiy, A. I. Timoshenko, L. A. Gravel, and Yu. B. Novikov *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 55 Transl. into ENGLISH from Sverkhtverdyye Materialy (Kiev, USSR), no. 6, Nov. - Dec. 1986 p 7-12 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21273# Joint Publications Research Service, Arlington, Va.
THE UNIQUE CHARACTERISTICS OF THE STRUCTURE OF COMPOSITE MATERIALS MADE ON A BASE OF SPHALERITE-ANALOGOUS BORON NITRIDE Abstract Only
A. I. Ignatusha, A. V. Lysenko, V. G. Delevi, S. A. Bozhko, A. A. Svirid, Ye. S. Cherepenina, and N. G. Bagno *In its* JPRS Report: Science and Technology. USSR: Materials Science 9 Nov. 1987 p 58 Transl. into ENGLISH from Sverkhtverdyye Materialy (Kiev, USSR), no. 6, Nov. - Dec. 1986 p 24-28 (For primary document see N88-21261 14-24)
Avail: NTIS HC A05/MF A01

N88-21770# Joint Publications Research Service, Arlington, Va.
THEORY OF MUON METHOD FOR STUDY OF SOLID AND LIQUID HYDROGEN Abstract Only
Yu. M. Belousov and V. P. Smilga *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 15 Transl. into ENGLISH from Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 92, no. 4, Apr. 1987 p 1151-1159 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21782# National Bureau of Standards, Gaithersburg, Md.
OPTICAL COOLING AND TRAPPING
William D. Phillips *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 13-35 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21783# Bell Telephone Labs., Inc., Holmdel, N. J.
OPTICAL TRAPPING OF NEUTRAL ATOMS AND DIELECTRIC PARTICLES BY RADIATION PRESSURE
A. Ashkin, J. E. Bjorkholm, and S. Chu *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 36-69 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21784# Essen Univ. (West Germany).
MACROSCOPIC QUANTUM JUMPS IN A SINGLE ATOM
Axel Schenzie and Richard G. Brewer (International Business Machines Corp., San Jose, Calif.) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 70-89 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21785# Tokyo Univ. (Japan).
LASER COOLING OF NEON METASTABLE STATES
Fujio Shimizu, Kazuko Shimizu, and Hiroshi Takuma (University of Electro-Communications, Tokyo, Japan) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical

Aspects of Quantum Electronics 1987 p 90-103 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-21824# Continuous Electron Beam Accelerator Facility, Newport New, Va.
SUPERCONDUCTING RF AND BEAM-CAVITY INTERACTIONS
Joseph J. Bisognano [1988] 14 p
(Contract DE-AC05-84ER-40150)
(CEBAF-PR-88-004) Avail: NTIS HC A03/MF A01

Beam-cavity interactions can limit the beam quality and current handling capability of linear and circular accelerators. These collective effects include cumulative and regenerative transverse beam breakup (BBU) in linacs, transverse multipass beam breakup in recirculating linacs and microtrons, longitudinal and transverse coupled-bunch instabilities in storage rings, and a variety of transverse and longitudinal single-bunch phenomena (instabilities, beam breakup, and energy deposition). The superconducting RF (SRF) environment has a number of features which distinguish it from room temperature configurations with regard to these beam-cavity interactions. Typically the unloaded Qs of the lower higher-order modes (HOM) are at the 10 to the 9th level and require significant damping through couplers. High gradient CW operation, which is a principle advantage of SRF, allows for better control of beam quality, which for its preservation requires added care with respect to collective phenomena. Gradients are significantly higher than those obtainable with pulsed copper cavities. Finally, energy deposition by the beam into the cavity can occur in a cryogenic environment. In this note those characteristics of beam-cavity interactions which are of particular importance for superconducting RF cavities are highlighted.
Author

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N88-21825# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ERROR REDUCTION IN TWO-DIMENSIONAL PULSE-AREA MODULATION, WITH APPLICATION TO COMPUTER-GENERATED TRANSPARENCIES
M. J. Bastiaans and A. H. M. Akkermans (Philips International B.V., Eindhoven, Netherlands) May 1987 57 p
(EUT-87-E-172; ISBN-9-06-144172-2; ISSN-0167-9708; ETN-88-91819) Avail: NTIS HC A04/MF A01

The synthesis of band-limited functions that are generated by properly low-pass filtering a regular array of area-modulated unit-height pulses is considered. Simply choosing the pulse areas proportional to the corresponding sample values of the band-limited function to be generated, would result in an error. The exact relationship between the pulse areas and the corresponding sample values of the band-limited function to be synthesized is derived. Error reduction can be achieved by using this relationship to calculate the pulse areas from the required sample values; in principle, a band-limited function can thus be realized to any degree of accuracy. It is shown which amount of error reduction can be obtained, when only a limited number of terms of the exact relationship is taken into account. The application to computer-generated half-tone transparencies is described. ESA

N88-21826# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. fuer Technische Physik.
BEAM QUALITY OF STABLE AND UNSTABLE RESONATORS: A THEORETICAL APPROACH
Thomas Hall Aug. 1987 56 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1103)
(DFVLR-FB-87-35; ISSN-0171-1342; ETN-88-91919) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000 Cologne, Fed. Republic of Germany, 21 Deutsche marks

An iterative solution of the generalized Kirchhoff-Fresnel integral equation is used to determine the modes, near field, and field distributions of several resonators. The beam quality depends on the Fresnel number for stable and on the equivalent Fresnel number for unstable resonators, respectively. The laser channel partially shading the resonator mirror and the density variation in the gas flow diminish the beam quality. Ways to compensate the effect of a density variation are presented. ESA

N88-21827# Elettronica S.R.L., Rome (Italy).
MID INFRARED MULTICHANNEL FOCAL PLANE BREADBOARD Final Report
Paris, France ESA 17 Jul. 1987 52 p
(Contract ESTEC-6472/85-NL-IW(SC))
(RT-87/014; ESA-CR(P)-2533; ETN-88-91968) Copyright Avail: NTIS HC A04/MF A01

Linear arrays of nonstaggered IR detectors and technologies for assembling a couple of linear arrays into a focal plane by mechanical butting were developed. The realization of very small dark space between pixels and the possibility to realize a butting with minimum pixel loss at the interfacing edge of the arrays are discussed. Arrays of 128 elements were considered, but information to design a set of masks to realize 2 truly linear arrays of 3072 elements butted and aligned on a focal plane was obtained. At the butting interface the target of 1 pixel loss is reached and the procedure to align the 2 arrays is satisfactory and reliable. From the point of view of the optoelectronic characteristics, a big problem is the impossibility to make a selection of the substrates by a probe card. That is why some proposed targets are not reached and statistical measurements not carried out. Nevertheless attention was paid in testing the pixels next to the butting edge to be sure that they are not affected by the previous working on substrate, and they show results within the media of all other normal pixels. ESA

N88-21828# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Lasertechnik.
AEROSOL LIDAR FOR ENVIRONMENT PROTECTION AND METEOROLOGY
Christian Werner and Juergen Streicher Jan. 1987 179 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1105)
(DFVLR-FB-87-43; ISSN-0171-1342; ETN-88-92112) Avail: NTIS HC A09/MF A01; DFVLR, VB-PL-DO, Postfach 90 60 58, 5000, Cologne, Fed. Republic of Germany, 50 Deutsche marks

The technical realization of different lidar systems is described with respect to applications in environment protection and meteorology. Specifications for lasers, detectors, and data systems are given. The problem of eye safety for practical applications is discussed. Examples of lidar for slant-range visibility detection and plume dispersion measurements are presented. ESA

N88-21829# Royal Air Force Coll., Cranwell (England). Dept. of Electrical and Electronic Engineering.
THE APPLICATION OF THERMAL IMAGING SENSORS AND IMAGE PROCESSING TECHNIQUES TO A SHORT RANGE SURFACE-TO-AIR MISSILE SYSTEM M.S. Thesis
T. P. Dean 1987 210 p
(ETN-88-92080) Avail: NTIS HC A10/MF A01

The sensor requirements of a weapon system are outlined together with possible target cues. A typical system specification

is presented to provide the basis for imager performance analysis. A thermal imager environmental model and the basic theory of infrared radiation are introduced. Thermal imager concepts are reviewed. The theory of imager performance is considered. Image processing techniques which provide enhanced images or an improved classification capability (either by manual or automatic means) are reviewed. The demonstrated effectiveness of these techniques and whether they could be economically incorporated into the weapon system are considered. Thermal imager performance in the surveillance and tracking roles for the specified weapon system is evaluated. Performance limitations are highlighted. ESA

N88-21830# Rome Univ. (Italy). Dipt. di Fisica.
A NEW CLASS OF MULTIPLE DISPERSION GRATING SPECTROMETERS
V. Mazzacurati, P. Benassi, and G. Ruocco (Aquila Univ., Italy) 9 Oct. 1987 43 p
(Preprint-569; ETN-88-92260) Avail: NTIS HC A03/MF A01

The characteristics of a double pass double monochromator spectrometer design for low frequency light scattering studies are reported. Preliminary spectra are presented to show the high resolving power achieved with a free spectral range of 2000 cm sup -1, as well as the high luminosity, contrast, and stability. Spectra obtained with a single pass Fabry-Perot interferometer are also show for comparison. ESA

N88-21831# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UTILIZATION OF SPACE COLOR TRANSFORMATION, LINEAR CONTRAST AND FILTRATION FOR ENHANCEMENT OF COLORED DIGITAL IMAGES [UTILIZACAO DE TRANSFORMACAO NO ESPACO DE CORES, CONTRASTE LINEAR E FILTRAGEM PARA REALCE DE IMAGENS COLORIDAS DIGITAIS]
Luciano VieiraDutra and Paulo Roberto Meneses Aug. 1987 8 p In PORTUGESE Presented at the 10th National Congress of Applied Mathematics and Computation, Gramado, Brazil, 21-25 Sep. 1987
(INPE-4310-PRE/1176) Avail: NTIS HC A02/MF A01

Some methods are presented of color enhancement of digital images based on transformation for the space perceptive independent variable: intensity (I), hue (H), and saturation (S). In the space, IHS, diverse processes are now possible through the example of histogram manipulation of the components, filtration, and resampling. The self-sufficiency subject to the available accepted visual perception of the parameters in the IHS space takes away the best control of the results and the attainment of advantageous visual products for photointerpretation and representation. Author

N88-21320# Joint Publications Research Service, Arlington, Va.
ANISOTROPY OF LIGHT ABSORPTION BY COLOR CENTERS IN WAVEGUIDES PRODUCED ON PHOTOCHROMIC GLASSES BY DIFFUSION Abstract Only
L. B. Glebov, N. V. Nikonorov, G. T. Petrovskiy, and V. A. Tsekhomskiy *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 38 Transl. into ENGLISH from Fizika i Khimiya Stekla (Leningrad, USSR), v. 12, no. 5, Sep. - Oct. 1986 p 549-554 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21321# Joint Publications Research Service, Arlington, Va.
DEPENDENCE OF FORMATION OF RADIATIVE COLOR CENTERS IN OPTICAL GLASS FIBERS ON TECHNOLOGICAL FACTORS Abstract Only
Ye. M. Dianov, V. N. Karpechev, N. S. Karpychev, L. S. Korniyenko, S. M. Mazavin, S. I. Miroshnichenko, A. O. Rybaltovskiy, and P. V. Chernov *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 39 Transl. into ENGLISH from Fizika i Khimiya Stekla (Leningrad, USSR), v. 12, no. 5, Sep. - Oct. 1986 p 555-561 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21791# Texas Univ., Austin. Dept. of Physics.
SQUEEZED STATES OF LIGHT Abstract Only
H. J. Kimble, R. J. Brecha, L. A. Orozco, M. G. Raizen, L. A. Wu, and M. Xiao *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 235-236 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21792# Bell Telephone Labs., Inc., Murray Hill, N. J.
PULSED SQUEEZED LIGHT
R. E. Slusher *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 237-252 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21793# International Business Machines Corp., San Jose, Calif.
QUANTUM NONDEMOLITION DETECTION AND SQUEEZING IN OPTICAL FIBERS
M. D. Levenson, R. M. Shelby, and S. H. Perimutter *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 253-267 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21796# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
FREE CARRIER NONLINEAR OPTICS
P. A. Wolff *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 327-343 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21797# California Univ., Berkeley.
BERRY'S PHASE IN FIBER OPTICS
R. Y. Chiao *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 344-363 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21809# Kyoto Univ. (Japan). Dept. of Physics.
RECENT PROGRESS IN OPTICAL BISTABILITY AND TRISTABILITY
T. Yabuzaki and M. Kitano *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 552-574 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21810# Northwestern Univ., Evanston, Ill. Dept. of Electrical Engineering and Computer Science.
NONCLASSICAL LIGHTS
Horace P. Yuen *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 575-600 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21984# Observatoire de Besancon (France).
THE LIGHT CURVE OF P/HALLEY AND THE ROTATION OF ITS NUCLEUS
M. C. Festou, P. Drossart, J. Lecacheux, T. Encrenaz, F. Puel, and J. L. Kohl-Moreira (Observatoire de Paris-Meudon, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 695-701 (For primary document see N88-21884 14-91)
Copyright Avail: NTIS HC A99/MF E03

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-21832# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
IONIZATION EQUILIBRIUM AND RADIATIVE ENERGY LOSSES IN A STATIONARY PLASMA
M. V. Fedulov 1986 24 p In RUSSIAN
(DE88-700856; IAE-4369/6) Avail: NTIS (US Sales Only) HC A03/MF A01

Calculational model for determining ionization equilibrium, energy level population density and radiative energy losses from a high temperature homogeneous stationary plasma is described. Calculational results for optically transparent plasma and under final characteristic dimensions of region, occupied by plasma, are presented. The model allows one to perform calculations for plasma, containing ions with the electron number, which does not exceed 10 to 12. DOE

N88-21833# Japan Atomic Energy Research Inst., Tokyo.
CONSISTENCY BETWEEN CURRENT RAMP-UP/RECHARGING SCENARIO BY NON-INDUCTIVE CURRENT DRIVE AND DENSE AND COLD DIVERTOR PLASMA. CONCEPTUAL DESIGN STUDY OF FY86 FER
Shigehisa Hitoki, Masayoshi Sugihara, Shin Yamamoto, Mitsushi Abe, Noriaki Ueda, Takashi Okazaki, Kunihiko Okano, Masao Kasai, Kichiro Shinya, and Akiyoshi Hatayama et al. Aug. 1987 39 p In JAPANESE; ENGLISH summary
(DE88-751438; JAERI-M-87-109) Avail: NTIS (US Sales Only) HC A03/MF A01

Consistency between non-inductive current drive and the formation of cold and dense divertor plasma in phases of plasma current ramp-up and recharging. When we consider the current drive efficiency obtained in the experiments of JT-60 as the actual upper limit, it is difficult to realize the low plasma temperature below 50 eV near the divertor plate for the reasonable absorbed power (20 MW) in FER. Divertor plasma temperature is reduced to about 20 eV for the absorbed power 30 MW. It is essentially important to increase the drive efficiency in order to attain the cold divertor plasma. When we use the slightly higher efficiency model than the experimental result of JT-60, the divertor plasma temperature will be reduced to 20 eV and about 10 eV for the absorbed power 20 MW and 30 MW respectively. DOE

N88-21834# Japan Atomic Energy Research Inst., Tokyo.
PRELIMINARY ANALYSIS ON PLASMA EQUILIBRIUM CONTROL. CONCEPTUAL DESIGN STUDY OF FY86 FER
Mitsushi Abe, Kazuhiro Takeuchi, and Noriaki Ueda Aug. 1987 16 p In JAPANESE; ENGLISH summary
(DE88-751441; JAERI-M-87-116) Avail: NTIS (US Sales Only) HC A03/MF A01

Survey of the plasma experiments about dependence of plasma confinement on plasma shaping, prescription of the space state equation for plasma shape control using MHD equilibrium equation and analysis of steady state deformation of plasma cross sectional shape due to plasma parameter disturbances were carried out for the sake of preliminary study of plasma equilibrium control in the Fusion Experimental Reactor (FER). Experiments so far showed that it is desirable to control plasma surface position within 1 cm error, but the analysis here showed that possible disturbance may shift it by 2 to 3 cm and it is difficult to control plasma whole surface in good accuracy only with the plasma position control coils which is placed at the inner area of the toroidal coils. DOE

N88-21835# MSE, Inc., Butte, Mont.
A GENERAL 2D ELECTRICAL MODEL FOR DIAGONALLY CONNECTED MHD GENERATORS
V. W. Daniel Dec. 1987 32 p
(Contract DE-AC07-78ID-01745)
(DE88-004283; MHD-D131) Avail: NTIS HC A03/MF A01

A general 2D electrical model for diagonally connected MHD generators has been developed that solves for the steady state electric fields inside the channel and throughout the external network with a minimum of assumptions on the nature of the generator. Nonuniformities on the cathode wall and slag leakage on all walls enter naturally into the mathematical formulation. The mathematical model treats external networks of arbitrary complexity, including those with current controllers and power shufflers. The finite element computer model simulates the effects of arcing on the electrode walls and calculates the cathode wall shorting pattern via the current reversal mechanism. Data generated by the electrical model simulating the Component Development and Integration Facility (CDIF) 1A generator is compared to experimental data. DOE

N88-21836# Institut Franco-Allemand de Recherches, St. Louis (France).
ONE DIMENSIONAL CALCULATION MODEL FOR LASER PRODUCED PLASMAS EXPANDING IN VACUUM [EINDIMENSIONALES RECHENMODELL FUER INS VAKUUM EXPANDIERENDE LASERZEUGTE PLASMEN]
K. Daree 28 Oct. 1986 25 p In GERMAN
(ISL-R-128/86; ETN-88-91646) Avail: NTIS HC A03/MF A01

Calculations of the flow of expanding laser-produced plasmas close to the axis were compared with those of parallel flows and with experimental data. The characteristics of expanding and parallel flows are discussed. The one-dimensional calculation model is presented. Examples of flow calculations are given. The calculations require only relatively low calculation times, and have an extraordinary numerical accuracy as compared to two-dimensional simulations. The agreement with experimental results is very good. ESA

N88-21837# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
THE 1988 FAILURE RATE SCREENING DATA FOR FUSION RELIABILITY AND RISK ANALYSIS
L. C. Cadwallader and S. J. Piet Jan. 1988 80 p
(Contract DE-AC07-76ID-01570)
(DE88-006798; EGG-FSP-7922) Avail: NTIS HC A05/MF A01

This document contains failure rate screening data for application to fusion components. The screening values are generally fission or aerospace industry failure rate estimates that can be extrapolated for use by fusion system designers, reliability engineers and risk analysts. Failure rate estimates for tritium-bearing systems, liquid metal-cooled systems, gas-cooled systems, water-cooled systems and containment systems are given. Preliminary system availability estimates and selected initiating event frequency estimates are presented. This first edition document is valuable to design and safety analysis for the Compact Ignition Tokamak and the International Thermonuclear Experimental Reactor. DOE

N88-21838# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
BASIC PHYSICS OF LASER-PLASMA INTERACTIONS
S. G. Sajjadi Jul. 1987 32 p Prepared in cooperation with Rutherford High Energy Lab., Chilton (United Kingdom)
(ETN-88-92055) Avail: NTIS HC A03/MF A01

The wave equation is derived from Maxwell's equations and applied to a plasma to find the dispersion relation for transverse and longitudinal waves. The existence of waves in plasmas due to the oscillation of electrons (electron plasma waves, and those of ions - ion-acoustic waves) are considered and their dispersion relations discussed. The processes leading to the damping of these waves and the transfer of wave energy to thermal energy are also considered. The interaction of electromagnetic waves and particles, for example, the absorption of laser light through resonance absorption or inverse Bremsstrahlung, which lead to absorption of laser energy and heating of the plasma is treated. Brillouin scattering, Raman scattering, the two plasmon decay instability, and parametric decay instability are reviewed. ESA

N88-21839# Rome Univ. (Italy). Dipt. di Fisica.
CHAOTIC DIFFUSION ACROSS MAGNETIC FIELD IN A MODEL OF ELECTROSTATIC TURBULENT PLASMA
Marco Pettini, Angelo Vulpiani, Jacques H. Misguich, Michel DeLeener, John Orban, and Radu Balescu (Brussels Univ., Belgium) 2 Sep. 1987 55 p Submitted for publication Sponsored by the CNR
(Preprint-566; ETN-88-92258) Avail:* NTIS HC A04/MF A01

The guiding center motion (across a strong magnetic field) caused by a time dependent electrostatic field was studied using different nonlinear Hamiltonian systems of 1.5 degrees of freedom. The Hamiltonian is proportional to the electrostatic potential defined through its spatial Fourier spectrum in two dimensions. A k to the minus 3 power-law spectrum and random phase shifts model the spatial dependence of the electrostatic drift-wave turbulence observed in tokamaks. When the average electric field amplitude is larger than a threshold value, the particle trajectories become chaotic at large scale and a diffusion across the magnetic field sets in. The diffusion coefficient D was evaluated for different values of the average electric field amplitude A. The classical (quasi-linear) scaling is small A: D varies as A sq; transition to the Bohm scaling is found at higher amplitudes: D varies as A. For relative diffusion, the theoretical prediction of the so called clump effect is well confirmed by numerical simulations. Theory and simulation are in qualitative agreement for the dependence of D vs. A, but quantitative discrepancies exist. ESA

N88-21368# Joint Publications Research Service, Arlington, Va.
PARTICLE SIMULATION RESEARCH BY PLASMA PARAMETRIC HEATING CAUSED BY STRONG LASER
Chenghai Liu, Jiatai Zhang, Shugui Zhang, Shuzhen Yu, Huaxiang Liang, and Linbao Xu *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 19-29 Transl. into ENGLISH from Jisuan Wuli (Beijing, People's Republic of China), v. 2, no. 4, Dec. 1985 p 454-461 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21769# Joint Publications Research Service, Arlington, Va.
ALFVEN WAVES IN PLASMA WITH FINITE ION TEMPERATURES Abstract Only
V. P. Lakhin, A. B. Mikhaylovskiy, and A. I. Smolyakov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 13 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 92, no. 5, May 1987 p 1612-1617 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21772# Joint Publications Research Service, Arlington, Va.
THREE-WAVE PARAMETRIC RESONANCE IN PLASMA OF RELATIVISTIC ELECTRON FLUX Abstract Only
T. A. Davydova, V. P. Zakharov, and V. V. Kulish *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 21 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 4, Apr. 1987 p 687-694 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21895# Polish Academy of Sciences, Warsaw. Space Research Center.
SOME NEW FEATURES OF PLASMA WAVE PHENOMENA AT HALLEY: APV-N OBSERVATIONS
P. Oberc, W. Parzydlo, P. Koperski, D. Orlowski, and S. Klimov (Academy of Sciences, USSR, Moscow) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 89-9 (For primary document see N88-21884 14-91)
Copyright Avail: NTIS HC A99/MF E03

N88-21899# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
PLASMA PHENOMENA IN THE VICINITY OF THE CLOSEST APPROACH OF VEGA-1, 2 SPACECRAFT TO THE COMET HALLEY NUCLEUS
V. M. Balebanov, K. I. Gringauz, and M. I. Verigin *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 119-124 (For primary document see N88-21884 14-91)
Copyright Avail: NTIS HC A99/MF E03

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-21840# Sandia National Labs., Albuquerque, N. Mex.
CONSIDERATIONS IN GaAs STANDARD CELL DESIGN
M. Grohman and A. Conoscenti 1987 4 p Presented at the Southcon Conference, Orlando, Fla., 10 Mar. 1988 Prepared in cooperation with GigaBit Logic, Newbury Park, Calif.
(Contract DE-AC04-76DP-00789)
(DE88-003310; SAND-87-2828C; CONF-880340-1) Avail: NTIS HC A02/MF A01

A radar system being developed at Sandia National Laboratories is required to perform a phase comparison between a reference and received waveform. In order to increase the range accuracy, it is necessary for the phase difference to be measured at speeds approaching 1 nanosecond. This speed requires the use of GaAs technology. This paper briefly describes the design of a GaAs phase detector consisting of about 400 gates using standard cells. The integrated circuit was constructed and preliminary tests were made. DOE

N88-21841# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
AN OPTIMAL CMOS STRUCTURE FOR THE DESIGN OF A CELL LIBRARY
M. Dielen and J. F. M. Theeuwen Jan. 1987 63 p
(EUT-87-E-166; ISBN-9-06-144166-8; ISSN-0167-9708; ETN-88-91813) Avail: NTIS HC A04/MF A01

Possible CMOS design structures and theoretical models for these structures were reviewed. The general properties of CMOS are examined, and the CMOS inverter is dealt with, because this is the basic building block. The various structures of CMOS are examined, and structures suitable for polycell design are identified: And Or Invert circuits, pass transistor circuits, and domino CMOS. For every structure a theoretical model is formed and a SPICE simulation is performed. Domino CMOS is the most advantageous with respect to cell library design. ESA

N88-21842# Sandia National Labs., Albuquerque, N. Mex.
BREATHING MODE LATTICE RELAXATION ASSOCIATED WITH CARRIER EMISSION AND CAPTURE BY DEEP ELECTRONIC LEVELS IN SILICON
G. A. Samara 1987 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-003844; SAND-87-1600C; CONF-871124-28) Avail: NTIS HC A02/MF A01

The breathing mode (volume) lattice relaxations associated with carrier emission and capture are evaluated for a variety of deep levels in silicon using a recently proposed method based on high pressure measurement of the emission rates and capture cross sections. Included are: (1) the vacancy-like acceptor levels associated with the oxygen-vacancy pair (or A-center) and the gold, platinum and palladium impurities, (2) the chalcogenide donors in their singly- and doubly-charged states, and (3) a number of 3d transition metal donors. The signs and magnitudes (which range from approx 0 to 5 angstroms to the third power/emitted carrier) of these relaxations are discussed in terms of models for the

impurities and defects responsible for the associated levels. The results on the chalcogenides are compared with recent theoretical calculations. DOE

N88-21843# Illinois Univ., Urbana. Dept. of Materials Science and Engineering.
IN SITU TEM OBSERVATIONS OF HEAVY ION DAMAGE IN GALLIUM ARSENIDE
M. W. Bench, I. M. Robertson, and M. A. Kirk Jan. 1988 7 p Presented at the Fall Meeting of the Materials Research Society, Boston, Mass., 30 Nov. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-005984; CONF-871124-77) Avail: NTIS HC A02/MF A01

Transmission electron microscopy experiments have been performed to investigate the lattice damage created by heavy-ion bombardments in GaAs. These experiments have been performed in situ by using the HVEM - Ion Accelerator Facility at Argonne National Laboratory. The ion bombardments (50 keV Ar+ and Kr+) and the microscopy have been carried out at temperatures ranging from 30 to 300 K. Ion fluences ranged from 2 x 10 to the 11th power to 5 x 10 to the 13th ions/sq cm. Direct-impact amorphization is observed to occur in both n-type and semi-insulating GaAs irradiated to low ion doses at 30 K and room temperature. The probability of forming a visible defect is higher for low temperature irradiations than for room temperature irradiations. The amorphous zones formed at low temperature are stable to temperatures above 250 K. Post-implantation annealing is seen to occur at room temperature for all samples irradiated to low doses until eventually all visible damage disappears. DOE

N88-21844# Argonne National Lab., Ill.
ADVANCES IN APPLIED SUPERCONDUCTIVITY: A PRELIMINARY EVALUATION OF GOALS AND IMPACTS
A. M. Wolsky, E. J. Daniels, R. F. Giese, J. B. L. Harkness, L. R. Johnson, D. M. Rote, and S. A. Zwick Jan. 1988 171 p
(Contract W-31-109-eng-38)
(DE88-006441; ANL/CNSV-64) Avail: NTIS HC A08/MF A01

This document is meant to aid the U.S. Department of Energy, Assistant Secretary for Conservation and Renewable Energy by discussing the likely impacts of recent results from research on superconducting materials. The discussions in this document concern terrestrial applications that would substantially affect the production and use of electricity. The sections of the report each address a particular topic. The topics are: (1) electric generators, (2) transformers, (3) power transmission, (4) magnetic energy storage, (5) electric motors, (6) separation industry, and (7) maglev (magnetic-levitation) trains. DOE

N88-21845# Fondazione Ugo Bordoni, Rome (Italy).
CONTINUOUS COLLECTIVE MOLECULE ROTATION OF A NEMATIC LIQUID CRYSTAL INDUCED FROM LIGHT ANGULAR MOMENTUM [ROTAZIONE CONTINUA COLLETTIVA DI MOLECOLE DI UN CRISTALLO LIQUIDO NEMATICO INDOTTA DAL MOMENTO ANGOLARE DELLA LUCE]
Benedetto Daino, Marco Romagnoli, Marina Settembre, and Enrico Santamato Jul. 1986 6 p In ITALIAN
(FUB-17-1986; ETN-88-91874) Avail: NTIS HC A02/MF A01

A circularly polarized light beam of 514.5 nanometers wave length was projected on a 70 microns width nematic liquid crystal. It is found that when lower than a given threshold the light beam makes the crystal align in the propagation direction and the specimen is completely isotropic. At the threshold the state becomes unstable and evolves towards a new equilibrium, while the angle between the director axis and the optical axis becomes a function of the intensity. The liquid crystal becomes anisotropic and a continuous rotation of the entire structure is generated. The existence of a process equivalent to the Compton effect for free electrons, only that angular momemtum is involved, is suggested. ESA

N88-21846# Virginia Univ., Charlottesville. Dept. of Physics.
MAGNETIC IMPURITIES IN SUPERCONDUCTORS Performance Report, 1 Sep. 1987 - 31 Aug. 1988
J. Ruvalds 1988 25 p
(Contract DE-FG05-84ER-45113)
(DE88-006917; DOE/ER-45113/4) Avail: NTIS HC A03/MF A01

This paper documents investigations into the physics of superconductivity, especially cuprate materials. Research of plasmon mechanisms indicates the two-dimensional structure of Cu-O planes favors certain aspects of plasmon exchange as a source of electron pairing. This result suggests other alloys which may be high Tc superconductors. DOE

N88-21847# Argonne National Lab., Ill.
THE ELASTIC PROPERTIES OF MONOCLINIC ZrO2
M. V. Nevitt, S. K. Chan, J. Z. Liu, M. H. Grimsditch, and Y. Fang 1987 14 p Presented at the International Conference on Electronic Structure in Phase Stability in Advanced Ceramics, Argonne, Ill., 17 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-005920; CONF-870843-9) Avail: NTIS HC A03/MF A01

Ultrasonic and Brillouin scattering measurements at ambient temperature have been made on small single crystals of monoclinic ZrO2. Various features of the angular anisotropy in the acoustic longitudinal wave and shear wave velocities were established, and the elastic stiffness and compliance moduli were computed. Shallow minima in the transverse shear wave velocity in directions parallel to the a and c crystallographic axes were observed. We anticipate that acoustic shear wave softening will be observed in these directions when measurements are made at temperatures close to the monoclinic-tetragonal transformation. DOE

N88-21848# Argonne National Lab., Ill.
EXPERIMENTAL STUDIES OF ELASTIC PROPERTIES OF CRYSTALS BY BRILLOUIN SCATTERING
M. Grimsditch Jul. 1987 16 p Presented at the International Conference on Electronic Structure in Phase Stability in Advanced Ceramics, Argonne, Ill., 17 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-005923; CONF-870843-7) Avail: NTIS HC A03/MF A01

The use of Brillouin scattering as a tool for the investigation of elastic properties of materials is briefly reviewed. The advantages and disadvantages of Brillouin scattering compared with ultrasonic techniques are discussed. Examples of Brillouin scattering of LaNbO4 applied to the study of phase transitions are presented. An application to the study of thin films of irradiated Nb3Ir is also presented. Diamonds and pressurized helium are also studied. DOE

N88-21849# Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Materials Science and Technology.
STABILITY LIMITS IN THE MONOCLINIC-TETRAGONAL TRANSFORMATIONS OF ZIRCONIA
R. C. Garvie and S. K. Chan 1987 27 p Presented at the International Conference on Electronic Structure in Phase Stability in Advanced Ceramics, Argonne, Ill., 17 Aug. 1987 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31-109-eng-38)
(DE88-005924; CONF-870843-10) Avail: NTIS HC A03/MF A01

A variety of experimental data obtained from single crystals and powders of zirconia was examined to obtain the stability limits of the tetragonal and monoclinic phases. These limits are used to delineate the possible modes of transformation at different temperatures in the light of a nonclassical theory of nucleation. The theory predicts an asymmetric relation between three critical temperatures T*, T/sub o/, and T/sub c/. Transformation by nucleation and growth occurs only in the range T/sub o/-T/sub c/ during cooling and in the range T*-T/sub o/ during heating. Below T/sub c/, transformation proceeds homogeneously in a manner akin to spinodal decomposition. In the neighborhood of

T/sub c/, the metastable tetragonal phase can have a long lifetime. It is assumed that the driving mechanism of transformation comes from the partial softening of a particular shear mode of lattice vibration. An indirect evidence in support of this assumption comes from the linear relationship between the transformation temperature of a zirconia/hafnia solid solution and the reciprocal effective cation mass. DOE

N88-21850# Argonne National Lab., Ill.
BRILLOUIN SCATTERING AND TRANSMISSION ELECTRON MICROSCOPY STUDIES OF RADIATION-INDUCED ELASTIC SOFTENING, DISORDERING AND AMORPHIZATION OF INTERMETALLIC COMPOUNDS
P. R. Okamoto, L. E. Rehn, J. Pearson, R. Bhadra, and M. Grimsditch Nov. 1987 28 p Presented at the Conference on Solid State Amorphizing Transformation, Los Alamos, N. Mex., 10 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-005927; CONF-8708104-6) Avail: NTIS HC A03/MF A01

The crystalline-to-amorphous (c-a) phase transformation in the intermetallic compound, Zr3Al, during room temperature bombardment with 1.0-MeV Kr(+) has been investigated. Transmission electron microscopy and Brillouin scattering techniques were used to determine the lattice parameter and shear elastic constant as a function of the degree of long-range order. Results show that a large (approx 50%) elastic softening and dilatation strain (approx 3%) due to disordering precede the onset of amorphization. These results indicate that chemical disordering is an important driving force for the c-a transformation, and that the mechanism is an elastic shear instability. It is also shown that the volume dependence of the shear elastic constant associated with radiation-induced disordering and eventual amorphization is virtually identical to that associated with the heating to melting of many solids. The origin and implications of this parallelism between solid-state amorphization and melting are discussed. DOE

N88-21851# Los Alamos National Lab., N. Mex.
ORDERED STRUCTURES IN YBa2Cu3O/SUB 7-y/, La2Cu3O/SUB 7-y/, La/SUB 2-x/Sr/SUB x/CuO/SUB 4-PAR. DELTA/ AND RELATED PEROVSKITES
T. E. Mitchell, T. Roy, Z. Fisk, and J. L. Smith 1988 6 p Presented at the MRS High Temperature Superconductors, Reno, Nev., 4 Apr. 1988
(Contract W-7405-eng-36)
(DE88-006461; LA-UR-88-569; CONF-880481-1) Avail: NTIS HC A02/MF A01

Electron microscopy and electron diffraction studies have been performed on the superconducting oxides YBa2Cu3O(sub 7-y), GdBa2Cu3O(sub 7-y) and La(sub 2-x)Sr(sub x)CuO(sub 4 par. delta) as well as the related perovskites La2CuO4, Eu2CuO4 and Gd2CuO4. Extra reflections are commonly observed in all the cases. For example, in the 123 compounds, in situ heating leads to transformations from orthorhombic to tetragonal with a loss of twin structure; on cooling the oxygen vacancies re-order in the basal plane to give 1/3(100)° or 1/4(110)° diffraction spots. In tetragonal Eu2CuO4 and Gd2CuO4, the (001) diffraction patterns often have extra spots at 1/2(110)° or at 1/4(110)° positions. Extra spots are also observed in La2CuO4 (orthorhombic) but this is probably due to the space group being primitive rather than centered. These observations are discussed in terms of the ordering of oxygen vacancies in the Cu-O planes of the various perovskite structures. DOE

N88-21852# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
GRAIN BOUNDARIES Progress Report
R. W. Balluffi and P. D. Bristowe 1 Feb. 1988 9 p
(Contract DE-FG02-87ER-45310)
(DE88-006628; DOE/ER-45310/7) Avail: NTIS HC A02/MF A01

Quantitative measurements of grain boundary structure factors using x-ray diffraction have been performed on low angle (001) twist boundaries in gold. Also, a computer atomistic simulation program is being implemented to examine the equilibrium properties of a series of boundaries in gold. Simulation of boundaries at room temperature have been performed. Electron microscopy of grain boundary melting in aluminum was also performed. Results indicated an absence of melting. DOE

N88-21853# Centre National d'Etudes Spatiales, Toulouse (France). Groupe d'Etudes et de Recherches sur les Materiaux dans l'Espace.
PROCEEDINGS OF THE SEMINAR ON HYDRODYNAMICS AND CRYSTAL GROWTH [HYDRODYNAMIQUE ET CROISSANCE CRISTALLINE]
1987 169 p Partly in ENGLISH and FRENCH Seminar held in Toulouse, France, 7-8 Apr. 1987
(ETN-88-92025) Avail: NTIS HC A08/MF A01

Vapor phase crystal growth, liquid phase crystal growth, and solidification in a melt bath were discussed. For individual titles, see N88-21854 through N88-21860.

N88-21854# Institut de Mecanique des Fluides de Marseille (France).
NUMERICAL SIMULATIONS OF BUOYANCY DRIVEN FLOWS IN CYLINDERS AND CAVITIES FOR VAPOR CRYSTAL GROWTH
P. Bontoux, F. Elie, C. Smutek, G. P. Extremet, A. Randriamampianina, E. Crespo, H. Branger, and B. Roux *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 22-54 Repr. from NATO-AST Series on Interfacial Phenomena (New York, N.Y., Plenum Press), v. 2 (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

Complex flow configurations were studied using cylindrical ampoules where the axis is tilted (referring to the gravity field). Numerical methods based on spectral type approximations or finite differences were used to study the hydrodynamic aspects of crystal growth. The study of real flow configurations considered thermal convection and other physical mechanisms and boundary conditions. Two dimensional models were used to represent transport in the vessel symmetry plane. It is shown that the models allow the prediction of flow characteristics, and that they are necessary to analyze competition between the different mechanisms. The simulation and experimental results agree on the evaluation of the velocity fields. ESA

N88-21855# Centre National de la Recherche Scientifique, Meudon-Bellevue (France). Lab. d'Aerothermique.
PROBLEMS APPEARING AT INTERFACE BALANCES [PROBLEMES POSES PAR LES BILANS D'INTERFACE] c34
Roger Prudhomme *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 56-70 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

A generalization of the reduction of three dimensional problems to two dimensional expressions is attempted, and it is applied to the study of flames and reactive boundary limits. The balance equations are derived, recognizing that the application is limited to not too small curvature radius and not too large drawing ratio. It is shown that the flow laws are determined by use of Gibbs interphases. The choice of the problem parameters is discussed and recommendations for the choice of velocity, reference surface, and flow expressions are given. ESA

N88-21856# Provence Univ., Marseille (France). Systemes Energetiques et Transferts Thermiques.
VELOCITY AND CONCENTRATION FIELDS OVER A CRYSTAL GROWING IN A WATER SOLUTION. EXPERIMENTAL STUDY AND NUMERICAL SIMULATION [CHAMPS DE VITESSE ET DE CONCENTRATION AU DESSUS D'UN CRISTAL QUI CROIT EN SOLUTION AQUEUSE. ETUDE EXPERIMENTALE ET SIMULATION NUMERIQUE]
B. Simon, J. M. Cherel, and P. Haldenwang *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987

p 71-78 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

A sodium chlorate crystal was made to grow in a supersaturated solution. The cell is tilted to 50 deg towards the vertical. It is shown that the observed convection is due to the crystallization only, while the thermal convection effect remains negligible. At high Rayleigh numbers, growth velocity numerical predictions are verified with satisfactory accuracy. The calculations allow to predict a convective regime in microgravity conditions for Rayleigh numbers of the order of 100 million. ESA

N88-21857# Commissariat a l'Energie Atomique, Grenoble (France). Lab. d'Etude de la Solidification.
TRANSPORT PROCESSES DURING DIRECTIONAL SOLIDIFICATION AND CRYSTAL GROWTH: SCALING AND EXPERIMENTAL STUDY
D. Camel and J. J. Favier *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 80-104 Sponsored in part by ESA, Paris, France (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

A case where the convection driving force is external to the fluid boundaries and where the solidification front is a plane at a macroscopic scale, which is typical of a crystal growing from its melt is analyzed. The scaling laws defining the extension of the fluid boundary limits and the amplitude of the radial and longitudinal segregations are established. It is shown that this analysis allows to interpret experimental and numerical data. The extension of the approach to the analysis of convection effects in eutectic and dendritic solidification is suggested. ESA

N88-21858# Ecole Normale Superieure, Paris (France).
SELECTIVE GROWTH VELOCITY IN NEEDLE CRYSTALS [SELECTION DE LA VITESSE DU CRISTAL EN AIGUILLE]
M. BenAmar *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 105-117 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

Velocity selection for a two dimensional crystal growing in liquid melt was analyzed. The analysis highlights the essential role played by the surface tension anisotropy in explaining the formation of such a crystal. The method can be extended to three dimensions if axial symmetry is maintained. The observed selectivity explanation is given. Kruskal and Segur analysis is suggested as a mathematical tool to understand experimental situations of further complexity. ESA

N88-21859# Institut de Mecanique des Fluides de Marseille (France).
HYDRODYNAMICAL REGIMES IN MOLTEN METALS UNDER A HORIZONTAL TEMPERATURE GRADIENT [REGIMES HYDRODYNAMIQUES DANS LES BAINS FONDUS METALLIQUES SOUMIS A UN GRADIENT DE TEMPERATURE HORIZONTAL] c34
Bernard Roux, Hamda BenHadid, and Patrice Laure (Nice Univ., France) *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 118-141 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

The onset of oscillatory regimes in molten metals at low Prandtl numbers is studied. Hydrodynamic experimental data are reviewed. The model is based on the Navier-Stokes equation coupled to energy transport equations. The flow is taken as laminar and Boussinesq approximation is used. The theoretical and numerical results explain the two dimensional oscillations appearing in the horizontal layers of the fluid. The existence of another type of oscillation, a three dimensional regime appearing at higher Prandtl numbers, is demonstrated. ESA

N88-21860# Brussels Univ. (Belgium). Dept. de Chimie-Physique.
CONVECTION EFFECTS ON STABILITY AT THE SOLIDIFICATION FRONT [EFFET DE LA CONVECTION SUR L'INSTABILITE AU FRONT DE SOLIDIFICATION]
M. Hennenberg, A. Rouzaud, D. Camel, and J. J. Favier (Commissariat a l'Energie Atomique, Grenoble, France) *In* CNES, Proceedings of the Seminar on Hydrodynamics and Crystal Growth 1987 p 142-167 In FRENCH (For primary document see N88-21853 14-76)
Avail: NTIS HC A08/MF A01

The instabilities at the crystal growth front during unidirectional solidification of a binary alloy are studied. The notion of boundary layer allows the definition of regions and the identification of the boundary layer width as a significant parameter. This interpretation using the width parameter summarizes all convective phenomena not related to the concentration gradient. The results are encouraging, but more theoretical and experimental work is necessary. ESA

N88-21861# Technische Hogeschool, Eindhoven (Netherlands).
THE SHUBNIKOV DE HAAS EFFECT IN NARROW-GAP SEMIMAGNETIC SEMICONDUCTORS Ph.D. Thesis
Henricus Maria Anton Schleijpen 1987 157 p
(ETN-88-92249) Avail: NTIS HC A08/MF A01

The Shubnikov de Haas (SdH) effect in the narrow-gap semimagnetic semiconductors (Cd (1-x) Mn (x)) 3As2 and Hg (1-x) Mn (x) Se was studied. Band models for semimagnetic semiconductors were derived. Numerical calculation of the electron energy levels in Hg (1-x) Mn (x) Se is outlined. Experiments on the semiconductors are described. Distorted SdH signals are discussed. ESA

N88-21862# Rome Univ. (Italy). Dipt. di Fisica.
RENORMALIZED FERMI LIQUID THEORY FOR DISORDERED ELECTRON SYSTEMS AND THE METAL-INSULATOR TRANSITION
C. DiCastro 4 Nov. 1987 11 p Presented at the International Symposium on Anderson Localization, Tokyo, Japan, 16-18 Aug. 1987
(Nota-Interna-900; ETN-88-92254) Avail: NTIS HC A03/MF A01

Anderson localization and electron-electron interaction theory is reviewed. The Landau parameters, related to the interaction amplitudes, are renormalized by disorder and acquire a scale dependence. By studying their renormalization group equations, universality classes of the metal-insulator transition driven by the electron mutual interaction in the presence of disorder are obtained. Whenever there is a magnetic coupling in the system, the predictions of Fermi liquid theory for the disordered interacting electron systems fully check with experimental results. In the general case of nonmagnetic impurities, although the theoretical predictions of a strong enhancement of the spin susceptibility and of the specific heat coefficient are confirmed by the experiments, more theoretical and experimental work is required to fully understand the transition and distinguish between the various hypotheses. ESA

N88-21322# Joint Publications Research Service, Arlington, Va.
MODELING GROWTH OF INTERDENDRITIC SILICON RIBBONS Abstract Only
M. Ya. Dashevskiy, B. N. Azarenok, and D. M. Kiselev *In its* JPRS Report: Science and Technology. USSR: Materials Science 10 Aug. 1987 p 46 Transl. into ENGLISH from Izvestiya Akademii Nauk SSSR: Neorganicheskiye Materialy (Moscow, USSR), v. 22, no. 10, Oct. 1986 p 1589-1593 (For primary document see N88-21312 14-31)
Avail: NTIS HC A05/MF A01

N88-21370# Joint Publications Research Service, Arlington, Va.
SECONDARY ELECTRON EMISSION CHARACTERISTICS IMPROVED BY ION IMPLANTATION
Xianghuai Liu, Shichang Zou, and Yushan Tu *In its* JPRS

Report: Science and Technology. China 23 Nov. 1987 p 40-42 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 117-118 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21372# Joint Publications Research Service, Arlington, Va.
FIRST REPORT ON InGaAs HALL DEVICE
Yiyang Zheng, Jinchang Zheng, Yanfang Liu, Shaojin Peng, Wenhong Lu, Guixian Shen, Yingzhu Zhang, Guixiang Su, and Kuiyou Jia *In its* JPRS Report: Science and Technology. China 23 Nov. 1987 p 48-55 Transl. into ENGLISH from Dianzi Xuebao (Beijing, People's Republic of China), v. 15, no. 1, Jan. 1987 p 36-40 (For primary document see N88-21365 14-31)
Avail: NTIS HC A06/MF A01

N88-21753# Joint Publications Research Service, Arlington, Va.
EFFECT OF Mg IMPURITY ON LOCAL VIBRATIONS OF U-CENTERS IN LiF LATTICE Abstract Only
L. I. Bryukvina and V. M. Khulugurov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 1 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, May 1987 p 1525-1526 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21754# Joint Publications Research Service, Arlington, Va.
NEW METHOD OF EXAMINING MICRONONHOMOGENEITY OF LOCAL CENTERS IN HIGH-RESISTIVITY SEMICONDUCTOR MATERIALS UNDER SCANNING ELECTRON MICROSCOPE Abstract Only
A. V. Govorkov, E. M. Omelyanosvskiy, A. Ya. Polyakov, V. I. Raykhshteyn, and V. A. Fridman *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 2 Transl. into ENGLISH from Pisma v Zhurnal Fiziki (Leningrad, USSR), v. 13, no. 7, 12 Apr. 1987 p 385-388 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21755# Joint Publications Research Service, Arlington, Va.
INFRARED REFLECTION-ABSORPTION SPECTROSCOPY OF HYPERFINE LAYERS ON SURFACES OF SEMICONDUCTORS AND DIELECTRICS Abstract Only
S. N. Gruzinov and V. P. Tolstoy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 3 Transl. into ENGLISH from Zhurnal Prikladnoy Spektroskopii (Minsk, USSR), v. 46, no. 5, May 1987 p 775-780 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21756# Joint Publications Research Service, Arlington, Va.
BLOCH OSCILLATIONS IN SMALL JOSEPHSON JUNCTIONS: THEIR MANIFESTATION IN SWITCHING EFFECTS Abstract Only
R. O. Starobogatov and G. Yu. Yashin *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 3-4 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, May 1987 p 1580-1582 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21775# Joint Publications Research Service, Arlington, Va.
SUPERCONDUCTING TRANSITION TEMPERATURE OF Cu-Nb MICROCOMPOSITES Abstract Only
I. A. Kiyanskiy, T. I. Bryushkova, Yu. F. Bychkov, and A. Ya. Zhiltsov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 25 Transl. into ENGLISH from Fizika Tverdogo Tela (Leningrad, USSR), v. 29, no. 4, Apr. 1987 p 1203-1205 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21776# Joint Publications Research Service, Arlington, Va.
THERMAL MODEL DESCRIBING DEVELOPMENT OF NORMAL REGION IN SUPERCONDUCTOR FILM CARRYING ELECTRIC CURRENT Abstract Only
O. G. Vendik, O. V. Pakhomov, and L. L. Tereshchebko *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 26 Transl. into ENGLISH from Zhurnal Tekhnicheskoy Fiziki (Leningrad, USSR), v. 57, no. 4, Apr. 1987 p 663-668 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21777# Joint Publications Research Service, Arlington, Va.
GIANT JOSEPHSON SIGNAL IN WIDE SUPERCONDUCTING FILMS Abstract Only
Yu. M. Ivanchenko, P . N. Mikheyenko, and Ya. I. Yuzhelevskiy *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 27 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (USSR), v. 45, no. 10, 25 May 1987 p 483-486 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21778# Joint Publications Research Service, Arlington, Va.
ORGANIC METAL (ET)4Hg3Br8A QUASI-TWO-DIMENSIONAL SUPERCONDUCTOR Abstract Only
R. N. Lyubovskaya, Ye. A. Zhilyayeva, A. V. Zvarykina, V. N. Laukhin, R. B. Lyubovskiy, and S. I. Pesotsky *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 28 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 416-418 Original language document was announced in IAA as A87-52815 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21779# Joint Publications Research Service, Arlington, Va.
PROPERTIES OF SUPERCONDUCTORS WITH STRONG ELECTRON-PHONON INTERACTION Abstract Only
L. N. Bulayevskiy and O. V. Dolgov *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 28 Transl. into ENGLISH from Pisma v Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (Moscow, USSR), v. 45, no. 9, 10 May 1987 p 413-415 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

N88-21786# Tokyo Univ. (Japan). Dept. of Applied Physics.
GIGANTIC OPTICAL NONLINEARITY IN LOW DIMENSIONAL SYSTEMS
Eiichi Hanamura *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 104-116 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21787# University of Southern California, Los Angeles. Center for Laser Studies.
MEASUREMENTS OF OPTICAL NONLINEARITIES IN MOCVD-GROWN GaAs/GaAlAs MULTIPLE QUANTUM WELLS
E. Garmire *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 117-127 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21790# Keio Univ., Yokahama (Japan). Dept. of Physics.
SQUEEZED STATE IN DEGENERATE PARAMETRIC AMPLIFICATION DISCUSSED BY H. TAKAHASI IN 1963
Koichi Shimoda *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 216-234 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21794# Hiroshima Univ. (Japan). Dept. of Physical Electronics.
OPTICAL PROPERTIES OF QUANTUM WELL STRUCTURES WITH ELECTRIC FIELD: LIFE TIME FREE SWITCHING OF LUMINESCENCE INTENSITY AND VIRTUAL CHARGE-INDUCED ULTRAFAST OPTICAL NONLINEARITY
Masamichi Yamanishi *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 268-303 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21795# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan).
ENHANCED EXCITONIC OPTICAL NONLINEARITY AND EXCITON DYNAMICS IN SEMICONDUCTOR MICROSTRUCTURES
T. Takagahara *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 321-326 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21798# Bell Telephone Labs., Inc., Holmdel, N. J.
HIGH DENSITY FEMTOSECOND EXCITATION OF NONTHERMAL CARRIER DISTRIBUTIONS IN INTRINSIC AND MODULATION DOPED GaAs QUANTUM WELLS
Wayne H. Knox, Daniel S. Chemla, and Gabriela Livescu *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 364-376 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21799# Tsukuba Univ., Ibaraki (Japan). Inst. of Physics.
DYNAMICAL ASPECTS OF CARRIER TUNNELING IN SEMICONDUCTOR SUPERLATTICES
Yasuaki Masumoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 377-394 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21800# Arizona Univ., Tucson. Optical Sciences Center.
EXPERIMENTAL AND THEORETICAL STUDIES OF COHERENT AND NONTHERMAL PROCESSES IN SEMICONDUCTORS PROBED BY FEMTOSECOND LASER TECHNIQUES
N. Peyghambarian and S. W. Koch *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 396-414 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21801# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
FEMTOSECOND STUDIES IN HOT CARRIER RELAXATION IN GaAs AND AlGaAs
E. P. Ippen and J. G. Fujimoto *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 415-433 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21802# Yamaguchi Univ. (Japan). Dept. of Physics.
EXCITON RELAXATION PHENOMENA IN A DISORDERED SYSTEM
Masaki Aihara *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 434-437 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21803# Nippon Telegraph and Telephone Public Corp., Tokyo (Japan).
GENERATION OF NUMBER-PHASE MINIMUM UNCERTAINTY STATES
Y. Yamamoto, S. Machida, N. Imoto, M. Kitagawa, and G. Bjoerk *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 438-450 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21804# Northwestern Univ., Evanston, Ill.
SQUEEZING VIA TRAVELLING-WAVE FORWARD FOUR-WAVE MIXING IN ATOMIC VAPORS: COMPARISON WITH NONDEGENERATE THEORY
Prem Kumar *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 451-475 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21806# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
DETECTING SQUEEZED STATES BY CROSS-CORRELATION
Z. Y. Ou, C. K. Hong, and L. Mandel *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 489-502 Sponsored in part by NSF and by ONR Submitted for publication (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-21863# California Univ., Berkeley. Lawrence Berkeley Lab.
PREDICTION OF THERMODYNAMIC PROPERTIES, INCLUDING SOLUBILITY EQUILIBRIA AND VAPOR PRESSURES, FOR MIXED AQUEOUS ELECTROLYTES TO HIGH TEMPERATURES
R. T. Pabalan and K. S. Pitzer Jan. 1988 16 p Presented at the International Conference on Thermodynamics of Aqueous Systems with Industrial Applications, Warrenton, Va., 10 May 1987 Prepared in cooperation with California Univ., Berkeley
(Contract DE-AC03-76SF-00098)
(DE88-006317; LBL-24601; CONF-870594-4) Avail: NTIS HC A03/MF A01

A number of different models have been proposed in the literature that treat the thermodynamic properties of electrolyte solutions. The most frequently used at present is the ion-interaction or virial coefficient approach, which was initially developed by Pitzer (1973) and Pitzer and Kim (1974) for aqueous solutions near room temperature. Since the model is based on a general equation for the excess Gibbs energy of the aqueous fluid, any thermodynamic property can be obtained from the appropriate derivatives. Thus the model has been used to describe osmotic and activity coefficients, as well as volumetric and thermal properties (e.g., heat capacity and enthalpy) of aqueous electrolytes. Success of this model when applied to complex and concentrated electrolyte mixtures was initially demonstrated for calculations of equilibria at room temperature between a brine phase and one or more solids by Harvie and Weare (1980). In this study we show that the same success holds over a wider range of temperature conditions. The model is applied to calculations of solubility equilibria, as well as to calculations of vapor pressures of electrolyte mixtures to high temperatures. DOE

N88-21864# Stanford Linear Accelerator Center, Calif.
STRINGS IN FOUR DIMENSIONS

C. P. Bachas Jan. 1988 11 p Presented at the Conference on Perspectives in String Theory, Copenhagen, Denmark, 12 Oct. 1987
(Contract DE-AC03-76SF-00515)
(DE88-006435; SLAC-PUB-4534; CONF-8710282-1) Avail: NTIS HC A03/MF A01

The construction and properties of four dimensional string models are reviewed, using free fermions on the world-sheet. We prove that as opposed to gauge symmetries, broken space-time supersymmetry can only be restored continuously by decompactification. DOE

N88-21865# Rome Univ. (Italy). Dipt. di Fisica.
ON THE FEFFERMAN CLASS OF METRICS ASSOCIATED WITH A 3-DIMENSIONAL CAUCHY-RIEMANN (CR)-SPACE
Jerzy Lewandowski (Warsaw Univ., Poland) 3 Dec. 1987 6 p Sponsored in part by the Polish Ministry of Science and Higher Education
(Preprint-579; ETN-88-92268) Avail: NTIS HC A02/MF A01

The explicit forms of Fefferman's metric for a Cauchy-Riemann space are derived admitting a solution of the tangential Cauchy-Riemann equation and of the corresponding Weyl tensor. It is shown that its Petrov type is 0 in the case of the hyperquadric, or N in all other cases, and that the Fefferman class of metrics does not contain any nonflat solution of Einstein's vacuum equations with cosmological constant. ESA

N88-21811# Waikato Univ., Hamilton (New Zealand). Dept. of Physics.
QUANTUM STATISTICS OF PARAMETRIC OSCILLATORS ABOVE THRESHOLD
D. F. Walls, M. J. Collett, A. S. Lane, M. D. Reid, and C. M. Savage (Arizona Univ., Tucson.) *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 601-627 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

N88-21812# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
OPEN QUESTIONS IN CLOSED-LOOP PHOTODETECTION
Jeffrey H. Shapiro *In* National Science Foundation, United States-Japan Seminar on Quantum Mechanical Aspects of Quantum Electronics 1987 p 628-660 (For primary document see N88-21781 14-70)
Avail: NTIS HC A99/MF A01 CSCL 20C

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-21866# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN AEROSPACE] Annual Report, 1986
Jun. 1987 19 p
(ETN-88-91978) Avail: NTIS HC A03/MF A01

Aerospace research management and organization are described, and patents are listed. ESA

N88-21867* National Aeronautics and Space Administration, Washington, D.C.
MANAGEMENT: A BIBLIOGRAPHY FOR NASA MANAGERS
Apr. 1988 158 p
(NASA-SP-7500(22); NAS 1.21:7500(22)) Avail: NTIS HC A08 CSCL 05A

This bibliography lists 653 reports, articles and other documents introduced into the NASA scientific and technical information system in 1987. Items are selected and grouped according to their usefulness to the manager as manager. Citiations are grouped into ten subject categories; human factors and personnel issues; management theory and techniques; industrial management and manufacturing; robotics and expert systems; computers and information management; research and development; economics, costs and markets; logistics and operations management, reliability and quality control; and legality, legislation, and policy. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-21868# V.I. Corp., Amherst, Mass.
DATAVIEWS: A PERSONALIZABLE, INTERACTIVE, DATA DISPLAY SYSTEM FOR THE DECISIONMAKER Final Report, 1 Jul. 1983 - 31 Jul. 1985
Alan C. Morse, Elizabeth Kohler, Jefferson Koonce, and Nancy Tanner (Massachusetts Univ., Amherst.) 1 Oct. 1987 62 p
(Contracts N00014-83-C-0495; DA Proj. R18-68801)
(AD-A188509; Rept-87-10-1) Avail: NTIS HC A04/MF A01 CSCL 12E

The development of a highly interactive, personal data exploration system (DataViews) is described. The system started as a subroutine library for creating dynamic graphs of data. Using a menu specification system, an interface was developed. This interface evolved through three versions with the help of user feedback, advice from human factor experts, and our own experiments, into an easy to use and powerful system. In addition, an experiment was devised to demonstrate the value of the system as a tool for human factors experimentation. In that experiment, we used the system to compare three data display techniques (analog coding, digital coding, and pictorial encoding) in conjunction with redundant color coding. GRA

N88-21869# Department of Energy, New York. Environmental Measurements Lab.
A DATA ACQUISITION SYSTEM FOR ATMOSPHERIC TRACER STUDIES
M. Polito Dec. 1987 17 p
(DE88-006211; EML-500) Avail: NTIS HC A03/MF A01

An unusual data acquisition scheme is described for storing information electronically without the use of a microprocessor. The system had to be small and use low power devices to fit within battery operated field instruments. DOE

N88-21870# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMMON DATABASE INTERFACE FOR HETEROGENEOUS SOFTWARE ENGINEERING TOOLS M.S. Thesis
Ted D. Connally Dec. 1987 240 p
(AD-A189628; AFIT/GCS/ENG/87D-8) Avail: NTIS HC A11/MF A01 CSCL 12E

The project involved the design and implementation of a common database interface to integrate a set of heterogeneous software engineering tools. These tools are implemented on a variety of computer workstations, use incompatible data files, and provide little or no database support. The lack of database support and data sharing prevented having an integrated software design environment. The emphasis of this research was placed on implementing a fully functional database interface which integrating the existing tools and supports the addition of new tools as they

become available. The approach selected to implement the interface was the use of a standard data file and a data manager. The standard data file supports all data transfer and the data manager provides all database transaction support. The unique aspects of the interface is the ability of the standard date file to support multiple tools and the data manager's use of a generic data definition table. GRA

N88-21871# Army Engineer Topographic Labs., Fort Belvoir, Va.
AN OVERVIEW OF THE ARMY GIS (GEOGRAPHIC INFORMATION SYSTEMS) RESEARCH PROGRAM
Elizabeth D. Porter 23 Nov. 1987 13 p
(AD-A189711; ETL-R126) Avail: NTIS HC A03/MF A01 CSCL 08B

The U.S. Army Engineer Topographic Laboratories (USAETL) geographic information systems (GIS) research program seeks to define GIS requirements for operational use in the 1990's and beyond, and to develop advanced GIS processing techniques that will facilitate detailed, near-real time update and revision and terrain product generation. USAETL has initiated two new work units in the GIS technology base research program. The projects follow an earlier work unit, the Terrain Analyst Work Station (TAWS), which successfully demonstrated microcomputer-based GIS technology in field and Army garrison environments. From evaluations of TAWS demonstrations and development activities, researchers are proposing baseline Army GIS requirements and are working at developing corresponding performance standards. The functional requirements are the framework for the new work units, the Army GIS Evaluation (AGE) and the Soldier-to-GIS Interface Research (S-GIR). AGE is a study to test and evaluate off-the-shelf GIS with respect to meeting current and anticipated Army requirements for the management and manipulation of digital terrain data (DTD). S-GIR is a developmental effort which will study and prepare a sophisticated shell or front-end for GIS modules which will be selected (based on AGE study results) for use in a prototype advanced Army GIS. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-21539 Centre National d'Etudes Spatiales, Paris (France).
SPACE PROJECTS FOR THE 90'S RELEVANT TO CLIMATOLOGY [LES PROJETS SPATIAUX DES ANNEES 1990 INTERESSANT LA CLIMATOLOGIE]
Jean-Louis Fellous *In its* Climatology and Space Observations Sep. 1987 p 55-70 In FRENCH; ENGLISH summary (For primary document see N88-21536 14-42)
Copyright Avail: CEPADUES-Editions, 111 rue Nicolas-Vauquelin, 31100 Toulouse, France

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-21872# Office of Technology Assessment, Washington, D.C.
TECHNOLOGY TRANSFER TO CHINA. VOLUME 2: WORKING PAPERS, PART 1
Albert Keidel, Robert Bruce, D. F. Simon, J. McLucas, and D. G. Blaine Nov. 1987 472 p
(PB88-158704) Avail: NTIS HC A20/MF A01 CSCL 05A

The contents of this report on technology transfer to China (Volume 2) are as follows: The role of technology transfer for China's economic future; China's evolving computer industry; the role of foreign technology transfers; satellite telecommunications technology transfer to China; and, railroads of the People's Republic of China. GRA

N88-21873# Office of Technology Assessment, Washington, D.C.
TECHNOLOGY TRANSFER TO CHINA. VOLUME 2: WORKING PAPERS, PART 2
W. A. Fischer, A. Crane, T. Fingar, T. W. Robinson, and R. F. Grow Nov. 1987 400 p
(PB88-158712) Avail: NTIS HC A17/MF A01 CSCL 05A

The contents of this report on Technology Transfer to China are as follows: The transfer of western managerial knowledge to China; national security risks of dual-use transfers to China; politics, policy and China's future course; China's foreign policy, Beijing's military modernization and American policy alternatives; American firms and the transfer of technology to China; and, how business people view the process. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-21874# Academy of Sciences of the Armenian SSR, Erivan.
MODEL-INDEPENDENT REQUIREMENTS TO THE SOURCE OF POSITRONS IN THE GALACTIC CENTRE
F. A. Aharonyan 1986 22 p
(TI88-700968; EFI-929(80)-86) Avail: NTIS (US Sales Only) HC A03/MF A01

The main requirements, following from the observational data in a wide range of electromagnetic waves, to positron source in the galactic center are formulated. The most probable mechanism providing an efficiency of positron production of 10 percent is the pair production at photon-photon collisions. This mechanism can be realized: (1) in a thermal pair dominated mildly relativistic plasma, and (2) at the development of a nonthermal electromagnetic cascade initiated by relativistic particles in the field of X-rays. Gamma astronomical observations in the region of E sub gamma greater than or equal to 10 sup 10 to the 11th power eV can be crucial in the choice of the model. DOE

N88-21875# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
MEASUREMENTS OF THE SCINTILLATION TIME CONSTANTS OF INORGANIC CRYSTALS FOR THE DEVELOPMENT OF A TRIPLE-PHOSWICH DETECTOR FOR HIGH-ENERGY X-RAY QUANTA Thesis [MESSUNGEN DER SZINTILLATIONSZEIT-KONSTANTEN ANORGANISCHER KRISTALLE FUER DIE ENTWICKLUNG EINES DREIFACH-PHOSWICH - DETEKTORS FUER HOCHENERGETISCHE ROENTGENQUANTEN]
Thilo Michelis Apr. 1987 110 p In GERMAN Original document contains color illustrations
(ETN-88-91501) Avail: NTIS HC A06/MF A01

A setup for the measurement of the rise time distribution of pulses measured by a triple-Phoswich detector that is planned as component of an imaging system of a rotation-modulation telescope (RMT) was built. The principles and characteristics of scintillation crystals, scintillation detectors, and RMT's are outlined. Measurements on CsT(Tl) test crystals show a strong dependence of rise time distribution on Tl-concentration, and a clear dependence on temperature. A system for optimum light collection was developed for a Phoswich detector. The scintillation crystals NaJ(Tl) and CsJ(Na) are very suitable for a strip Phoswich. Proposals for a triple-Phoswich as detector for an RMT are given. ESA

N88-21876# Tata Inst. of Fundamental Research, Bombay (India).
FAR-INFRARED (120-300 MICRON) OBSERVATIONS OF THE CARINA NEBULA
S. K. Ghosh, K. V. K. Iyengar, T. N. Rengarajan, S. N. Tandon, R. P. Verma, and R. R. Daniel 1988 26 p Submitted for publication
Avail: NTIS HC A03/MF A01

The Carina nebula has been observed in a 120 to 300 micron wavelength with a 100 cm balloon-borne telescope, and maps have been generated with a spatial resolution of about one minute of arc. More than thirty compact sources were detected in the approx 0.5 degree area scanned; many of these sources do not have IRAS PSC counterparts. The diffuse emission accounts for nearly half of the total emission in the band. A comparison with observations at other wavelengths shows that the far-infrared emission is well correlated with other tracers of matter. The region appears to be rich in massive stars and most of the compact far-infrared sources are likely to be dust-gas clumps heated externally by these stars. Author

N88-21877# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
RANGE DETERMINATION OF PULSARS, TAKING INTO ACCOUNT H2 REGIONS Thesis [ENTFERNUNGSBESTIMMUNG VON PULSAREN UNTER BERUECKSICHTIGUNG VON HII-REGIONEN]
Christophe Beck Apr. 1987 117 p In GERMAN
(ETN-88-91492) Avail: NTIS HC A06/MF A01

The ranges of pulsars were determined using the dispersion of electromagnetic signals in interstellar plasma. The origin of pulsar radiation and the dispersion of pulsar radiation as a means to determine the extended HII-regions are discussed. The determination of electron density in interstellar space and in the HII-regions is explained. The computer program PDIST for the range determination of pulsars is enclosed. The results of the range determination are listed, and the spatial distribution of pulsars is discussed. ESA

N88-21878# Tuebingen Univ. (West Germany). Fakultaet fuer Physik.
DATA ANALYSIS OF AN OBSERVATION OF THE QUASAR 3C 273 IN THE HIGH-ENERGY X-RAY RANGE, AND THE SIGNIFICANCE FOR ASTROPHYSICAL MODELS Ph.D. Thesis [DATENANALYSE EINER BEOBACHTUNG DES QUASARS 3C 273 IM HOCHENERGIE-ROENTGENBEREICH UND DIE BEDEUTUNG FUER ASTROPHYSIKALISCHE MODELLE]
Monika Bezler 1987 83 p In GERMAN Previously announced in IAA as A85-42549
(ETN-88-91493) Avail: NTIS HC A05/MF A01

The data of an observation of the quasar 3C 273 using the balloon telescope High-Energy X-ray Experiment in the energy range between 10 and 200 keV were analyzed. An exponential law with a very flat slope (photon index of -1.2) is found. No cut-off is observed up to 240 keV. In comparison with the data of the satellite HEAO-A4 an increase in the luminosity by a factor of 3 is observed between 20 and 200 keV, with a significance of 6 standard deviations. A spectral change of 3C 273 in this energy range is observed. Models for active galaxies were checked. ESA

N88-21879# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
EXOSAT OBSERVATIONS OF ACTIVE GALAXIES IN THE MEDIUM-ENERGY X-RAY DOMAIN Thesis [EXOSAT - BEOBACHTUNGEN AKTIVER GALAXIEN IM MITTELENERGIE-ROENTGENBEREICH]
Michael Maisack Sep. 1986 67 p In GERMAN
(ETN-88-91499) Avail: NTIS HC A04/MF A01

Observations of active galaxies in the energy range between 1 and 50 keV were evaluated. Planning, construction, and instrumentation of the EXOSAT satellite are presented. The hardware and software used for the data evaluation are described. Active galaxies, classes of active galaxies, radiation mechanisms, and accretion disks are presented. The results of the observations largely confirm previous observations. Variability in time is observed on different time scales. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N88-21880# Tuebingen Univ. (West Germany). Fakultaet fuer Physik.
RADIATION TRANSPORT IN PLANETARY NEBULAE Ph.D. Thesis [STRAHLUNGSTRANSPORT IN PLANETARISCHEN NEBELN]
Gabriele Maluck 1986 110 p In GERMAN
(ETN-88-91500) Avail: NTIS HC A06/MF A01

Model calculations for planetary nebulae were performed, based on a spherically symmetric treatment. The ionization and energy equilibria were calculated. The photoionization cross sections, collision strengths, and transition probabilities are given. The structure of the nebula model, and the accompanying program and input data are presented. Model calculations for the planetary nebulae NGC 6572 and NBC 7662 using the global radiation model, in situ approximation, and without radiation transport are explained and compared. The model was tested on monochromatic recordings of planetary nebulae. ESA

N88-21881# Royal Observatory, Edinburgh (Scotland).
ROYAL OBSERVATORY, EDINBURGH: RESEARCH AND FACILITIES Annual Report, 1987
1987 127 p Original document contains color illustrations
(ISSN-0267-6281; ETN-88-91891) Copyright Avail: NTIS HC A07/MF A01

Research on the solar system (the role of comets in Earth history); the Galaxy (structure of the Galaxy, Galactic Center, star formation process, anomalies among early-type stars, the search for brown dwarfs, circumstellar dust, infrared spectroscopy of molecular clouds); and extragalactic space (stars and nebulae in the Magellanic Clouds, star formation in galaxies, the properties of active galaxies and quasars, the evolution of active galaxies and quasars at high redshifts) is summarized. Astronomical telescopes are described. ESA

N88-21882 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
A 23 HOUR EXOSAT OBSERVATION OF THE X-RAY PULSAR 1E2259+586 AND THE ASSOCIATED SUPERNOVA REMNANT G109.1-1.0
C. G. Hanson, K. Dennerl, M. J. Coe, and S. R. Davies (Southampton Univ., England) Sep. 1987 30 p Submitted for publication Sponsored by Max-Planck Gesellschaft and the United Kingdom Science and Engineering Research Council
(MPE-Preprint-99; ETN-88-91941) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The X-ray pulsar, 1E2259+586, and the associated supernova remnant, G109.1-1.0 were observed with the EXOSAT on 1984 December 1/2. The pulse period at this epoch was 6.978720 + or - 0.000006 (1 sigma) s, indicating that between 1981 and 1984 the pulsar was spinning down with an average secular rate of change of the spin period given by P dot/P = +(3.3 + or - 0.2) x 0.000001/yr. The pulse shape is stable on a time-scale of hours and shows energy dependence. Measured P dot is sufficiently small to exclude the possibility that this source is an isolated pulsar powered by rotational energy losses and so the pulsar is probably powered by accretion from a low mass companion. In the context of theories of accretion disk torques, 1E2259+586 is a fast rotator spinning at close to its equilibrium period. Data are not compatible with the 2300 s binary orbital solution reported by Fahlman and Gregory (1983) and analysis shows that the axsin(i) for this system less than or = to 160 lt-msec (3 sigma upper limit). The pulsed spectrum of 1E2259+586 is softer than that of any other known binary X-ray pulsar. Spectral fits indicate a thermal bremsstrahlung temperature of 1 keV or a power law photon index of 3.5. ESA

N88-21883# Tata Inst. of Fundamental Research, Bombay (India).
GLOBAL PROPERTIES OF STAR FORMATION IN SPIRAL GALAXIES
T. N. Rengarajan and K. V. K. Iyengar [1988] 16 p Submitted for publication
Avail: NTIS HC A03/MF A01

Samples of spiral galaxies from two catalogs of 21 cm line observations and a catalog of near-infrared observations of nearby galaxies were used in conjunction with Infrared Astronomical Satellite data to study correlations involving M sub G, the dynamic mass of the galaxies, the luminosities in the H band, the blue band, and the far-infrared bands, and the mass of atomic hydrogen. It is found that both the blue and the far-IR luminosities which are indicators of star formation averaged over approximately 3 x 10 to the 9th and 10 to the 7th years respectively, have a linear dependence on M sub G. On the other hand, the H luminosity which is a measure of star formation averaged over the lifetime of galaxies, has a steeper power law dependence on M sub G. The correlations observed do not have significant dependence on the morphological type of the galaxies. There is a poor correlation between the far-infrared luminosity and the mass of atomic hydrogen. The mass of atomic hydrogen has a dependence of the form M (sup 0.8)(sub G). Because of the decrease in the mean mass for later morphological types and due to differences in power law dependences for luminosities in different bands on M sub G, the mean value of luminosity to mass ratio is a constant for blue and far-IR bands, decreases for the H band and the gas to mass ratio increases as morphological type increases. Author

N88-21780# Joint Publications Research Service, Arlington, Va.
ROTATION OF UNIVERSE Abstract Only
D. D. Ivanenko and V. G. Krechet *In its* JPRS Report: Science and Technology. USSR: Physics and Mathematics 12 Feb. 1988 p 30 Transl. into ENGLISH from Izvestiya Vysshikh Uchebnykh Zavedeniy:Fiziki (Tomsk, USSR), v. 30, no. 3, Mar. 1986 p 12-16 (For primary document see N88-21751 14-70)
Avail: NTIS HC A03/MF A01

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-21884# European Space Agency, Paris (France).
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON THE DIVERSITY AND SIMILARITY OF COMETS
E. J. Rolfe, ed. and B. Battrick, ed. Sep. 1987 760 p Symposium held in Brussels, Belgium, 6-9 Apr. 1987; sponsored by ESA and the Belgian National Fund for Scientific Research Original contains color illustrations
(ESA-SP-278; ISSN-0379-6566; ETN-88-91972) Copyright Avail: NTIS HC A99/MF E03

Flyby missions and ground-based observations of comet plasmas, gas, dust, and nuclei, particularly Halley's comet, and future cometary missions (Giotto, sample return) were discussed. For individual titles, see N88-21885 through N88-21993.

N88-21885*# Toledo Univ., Ohio. Dept. of Physics and Astronomy.
DIVERSITY AND SIMILARITY OF COMETS
A. H. Delsemme *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 19-3 Sponsored in cooperation with NASA (For primary document see N88-21884 14-91)
(Grant NSF AST-86-11734)
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The evolution of comets from an early stage where they were all similar, to the later diversity is reviewed. The elemental abundances of all pristine comets are likely to be primitive, that is in solar abundance ratios for all elements including C, N, O, S, but with the exception of H (and assumedly He and Ne) that are severely depleted. The solid phase was originally in very fine grains, typically 0.1 micron or less, eventually sintered into larger grain clusters. The volatile phase contains H, C, N, O, and S molecules frozen in the pores of the grain clusters; cosmic ray plus solar irradiation changes the volatile to refractory ratio of the crust. Differences in dust tails, in plasma tails, in photometry between young and old comets, and in the variable carbon depletion of the gas phase seem to be induced by the decay processes. ESA

N88-21886*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Earth and Space Science Div.
HOW TYPICAL IS HALLEY'S COMET?
Paul R. Weissman *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 31-3 (For primary document see N88-21884 14-91)
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Comet Halley spacecraft encounters and observations in 1985 to 1986 are compared to all c omets, both long and short-period. Halley's orbit is quite unusual for a short-period (SP) comet, characterized by a very small perihelion distance and a retrograde inclination. The comet is much brighter than most SP comets, and is even relatively bright for a long-period comet. Although Halley's orbit crosses the orbits of seven of the nine planets, it can currently make close approaches to only Venus, Earth, and Mars, planets likely too small to have played a major role in capturing Halley to a short-period orbit. This, and other evidence, suggests that Halley has been in its current orbit for many returns. A variety of dynamical paths for evolving Halley to its present orbit from either the inner or outer Oort clouds are possible, and thus only probabilistic arguments can be made as to the comet's past physical and dynamical history. ESA

N88-21887# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Astronomy.
THE ABSOLUTE TOTAL MAGNITUDES OF PERIODIC COMETS AND THEIR VARIATIONS
L. Kresak and M. Kresakova *In* ESA, Proceedings of the

International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 37-4 (For primary document see N88-21884 14-91)
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Absolute total magnitudes of all periodic comets are determined. Since the available photometric data are strongly biased by instrumental effects (time-dependent and increasing with decreasing brightness), the list is based on the extreme magnitudes recorded during individual comet apparitions. Brightness dependence on the inverse 4th power of the heliocentric distance is assumed, and empirical corrections are applied to lower values of apparent brightness. The absolute magnitude distribution is found to be substantially different for the Jupiter family and for the Halley-type comets. There are only five statistically significant cases of progressive fading. The brightness decrease is found to be much slower than determined elsewhere, hardly discernible from irregular fluctuations, and affected by orbital changes. ESA

N88-21888# Sheffield Univ. (England). Dept. of Physics.
COMETARY MAGNITUDE DISTRIBUTION: THE TABULATED DATA
David W. Hughes *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 43-4 (For primary document see N88-21884 14-91)
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The numerical distribution of cometary absolute magnitudes is used to show the way in which cometary numbers vary as a function of the radius, activity, and mass of the cometary nucleus. Comets are divided into three groups according to their orbital periods. Tables listing all the known absolute magnitudes are provided. Graphs show how the cumulative number of comets, N, varies as a function of their absolute magnitude, H10 (the apparent magnitude a comet would have if it were 1 AU from both Sun and Earth). Typical relationships are, for long-period comets (P greater than 200 yr) log N = 0.549 + 0.30 H10 (for H10 less than 5.8 sup m), and for short-period comets (P less than 15 yr) log N = - 1.625 + 0.30 H10 (for H10 less than 10.8 sup m). ESA

N88-21889# Oxford Univ. (England). Dept. of Astrophysics.
THE COMET FLUX AND THE 15 MYR GALACTIC CYCLE
S. V. M. Clube *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 49-5 (For primary document see N88-21884 14-91)
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The 15 Myr terrestrial cycle in comet flux, due to the Sun's vertical motion through layers of zero tide on either side of the galactic plane, produced by the distribution of discrete clouds in an otherwise plane stratified disk, is discussed. Since the comet flux modulates the course of evolution by perturbing the boundary conditions at the core, outer mantle and atmosphere of the Earth, the otherwise unattributed 15 Myr cycle in the H-reversal record signifies ultimate galactic control. The effect places a significant constraint on the source of dark matter in the solar neighborhood. It is suggested that dark matter in galactic disks may exist in the form of relatively short-lived prestellar, substellar condensates or parent bodies, which may be identified with family of Jeans condensations spanning the range between giant comets and brown dwarfs. ESA

N88-21890# Tokyo Univ. (Japan). Inst. of Space and Astronomical Science.
SOLAR WIND OBSERVATION AT THE TIME OF CLOSEST ENCOUNTER WITH COMET HALLEY **c92**
K. I. Oyama and T. Abe (University of Electro-Communications, Tokyo, Japan) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 57-6 (For primary document see N88-21884 14-91)
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Solar wind measurements by the Sakigake satellite at 7 million km from Halley's comet are discussed. Small fluctuation of solar wind velocity due to H2O(+) ions were detected at the closest approach. Maximum fluctuation was detected between 22h30 and 24h00 on March 11, 1986. The time corresponds to the closest approach to the trajectory of comet Halley. This might suggest that H2O(+) remains along the path of comet Halley. ESA

N88-21891# Academy of Sciences, Graz (Austria). Inst. of Space Research.
VARIABILITY OF COMET HALLEY'S COMA: VEGA-1 AND VEGA-2 MAGNETIC FIELD OBSERVATIONS
K. Schwingenschuh, W. Riedler, H. I. M. Lichtenegger, J. L. Phillips, J. G. Luhmann, C. T. Russell, J. A. Fedder, A. Somogyi, and Ye. Yeroshenko (Academy of Sciences, USSR, Troitsk) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 63-6 (For primary document see N88-21884 14-91)
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The differences of the VEGA-1 and VEGA-2 magnetic field investigations near Comet Halley are discussed. The different draping structures of the magnetic field observed by VEGA-1 and VEGA-2 are caused by variations of the solar wind parameters and of the cometary activity during this period. The magnetic field reversal region observed only during the closest approach of VEGA-1 is correlated with high energetic particle streams and ground-based observations of a disconnection event. A broad minimum of the wave activity during the inbound phase of both encounters occurs in the same region where a substantial change of the slope of the total magnetic field and of the plasma velocity takes place and where the observed neutral gas density has a discontinuity. The VEGA-1 and -2 magnetic field observations are compared with the results of 3-D MHD computer simulations. It is concluded that most of the measured variability is the result of IMF variations. ESA

N88-21892# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
CALCULATION OF THE SHAPE OF THE CONTACT SURFACE AT COMET HALLEY
Zhen-jia Wu *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 69-7 (For primary document see N88-21884 14-91)
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Shapes of the contact surface of Comet Halley are calculated according to a model in which the position of the contact surface is determined by a balance between the magnetic field pressure and the ion-neutral drag. Shapes of the contact surface under various conditions show similar features: a round head and a finite tail. The size of the cavity is proportional to Q to the power 3/4, where Q is the water sublimation rate, and is inversely proportional to the square root of the total ram pressure of the solar wind. According to these relations, the dimension of the contact surface increases as the comet approaches the Sun. ESA

N88-21893*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE FORESHOCK REGION UPSTREAM FROM THE COMET HALLEY BOW SHOCK
S. A. Fuselier, K. A. Anderson, H. Balsiger, K. H. Glassmeier, B. E. Goldstein, M. Neugebauer, H. Rosenbauer, and E. G. Shelley (Lockheed Aircraft Corp., Palo Alto, Calif.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 77-8 Sponsored in cooperation with the Swiss National Science Foundation, Bern, Switzerland and BMFT, Bonn, Federal Republic of Germany (For primary document see N88-21884 14-91)
(Contract NASw-3729)
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A few hours prior to the crossing of the Comet Halley bow shock, the Giotto spacecraft intermittently encountered an electron foreshock region. The electron foreshock is characterized by magnetic connection to the cometary bow shock and increased field aligned electron heat flux directed away from the bow shock. A similar region was intermittently encountered by the ICE spacecraft prior to its crossing of the Giacobini-Zinner bow wave. During periods of magnetic connection with the Halley bow shock,

enhanced magnetic field fluctuations were observed. These enhancements are interpreted as indirect evidence of an ion foreshock in the electron foreshock. No clearly identifiable backstreaming protons are observed during these periods of magnetic connection, however, because it may be difficult to separate a backstreaming population from the cometary pick-up proton population already present in the upstream region. ESA

N88-21894# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
PHYSICAL PROCESSES IN THE VICINITY OF THE COMETOPAUSE INTERPRETED ON THE BASIS OF PLASMA, MAGNETIC FIELD AND PLASMA WAVE DATA MEASURED ON BOARD VEGA-2 SPACECRAFT
A. A. Galeev, K. I. Gringauz, S. I. Klimov, A. P. Remizov, R. Z. Sagdeev, S. P. Savin, A. Yu. Sokolov, M. I. Verigin, K. Szego, and M. Tatrallyay (Central Research Inst. for Physics, Budapest, Hungary) et al. *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 83-8 Prepared in cooperation with European Space Agency. European Space Research and Technology Center, and Academy of Sciences (USSR), Troitsk. (For primary document see N88-21884 14-91)
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The plasma, electric, and magnetic field data measurements performed by four different instruments near the cometopause of Halley's comet are discussed. No flow parameter displays any drastic variation at this boundary which separates two environments with different chemical composition. Fire-hose instability is possibly developing near the cometopause where the number of cometary ions significantly increases. The waves at the lower hybrid frequency and in the whistler range have similar amplitudes. ESA

N88-21895# Polish Academy of Sciences, Warsaw. Space Research Center.
SOME NEW FEATURES OF PLASMA WAVE PHENOMENA AT HALLEY: APV-N OBSERVATIONS **c75**
P. Oberc, W. Parzydlo, P. Koperski, D. Orlowski, and S. Klimov (Academy of Sciences, USSR, Moscow) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 89-9 (For primary document see N88-21884 14-91)
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The VEGA plasma wave measurements near Halley were processed by a procedure eliminating the nitrogen gas and dust interference from the spectrum measurements, and by a spectral analysis of the wave form data in the frequency range 1 to 10 Hz for E and P components. Features concerning the plasma waves related to the secondary wave and M1-boundary are found. Both spacecraft detect at the outer edge of the secondary wave a rapid increase of wave amplitudes at 1 to 10 Hz, as at a shock front. At the M1-boundary a broad minimum of wave activity is observed. On both sides of M1 there are 2 regions of enhanced turbulence at frequencies 0.1 to 1 kHz. The wave phenomena related to M1 are different at frequencies 1 to 10 Hz during two VEGA fly-by's. A comparison between VEGA and ICE wave observations shows that the amplitudes at Halley are an order of magnitude less than the peak values detected at Giacobini-Zinner in analogous regions and frequency ranges. ESA

N88-21896# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
A COMPARISON BETWEEN WAVE OBSERVATIONS PERFORMED IN THE ENVIRONMENTS OF COMETS HALLEY AND GIACOBINI-ZINNER
R. Grard, F. Scarf, J. G. Trotignon, and M. Mogilevsky (Academy of Sciences, USSR, Troitsk) *In its* Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 97-10 (For primary document see N88-21884 14-91)
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Amplitude and spectral features recorded by the ICE plasma wave instrument for the Giacobini-Zinner comet are compared with VEGA APV-V data for Halley. The better sensitivity of the ICE instrument makes easier the identification of phenomena such as electron plasma oscillations and the detection of weak turbulences at large distances from its nucleus. The magnetic antenna on ICE facilitates the differentiation between electromagnetic and electrostatic modes. The spectral amplitudes measured on the shock and foreshock regions are comparable for the two comets, and a general increase of wave activity is observed when the spacecraft enters the cometosheath. The data collected in the inner regions are drastically different. A significant reduction of wave activity is observed in the tail of Giacobini-Zinner, indicating that most of the solar wind energy is dissipated in the outer environment. A general increase of noise is observed at all frequencies after crossing the cometopause of Halley, due to the interaction of the plasma flow with the cometary medium and to the impact of dust particles. ESA

N88-21897# Academy of Sciences (USSR), Troitsk. Inst. of Terrestrial Magnetism and Radio Wave Propagation of the Academy of Sciences.
CORRELATION BETWEEN MAGNETIC AND ELECTRIC FIELD FLUCTUATIONS OBSERVED DURING FLYBY NEAR HALLEY'S COMET
Y. Mikhailov, O. Molchanov, M. Moguilevsky, E. Eroshenko, R. Grard, A. Pedersen, C. Beghin, J. G. Trotignon, V. Formisano, and K. Schwingenschuh (Academy of Sciences, Graz, Austria) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 109-112 (For primary document see N88-21884 14-91)
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The results of measuring the electric and magnetic fields and the plasma density fluctuations in the 0.001 to 0.5 Hz frequency band after traversing the shock wave during flyby near Halley's comet are discussed. The spectra of electric fields, density, and magnetic field Bz-component are of the same shape and exhibit a peak at 1.329 mHz. The electric-to-magnetic field ratio is proportional to the Alfven velocity, thereby confirming the MHD nature of the examined waves. ESA

N88-21898# Academy of Sciences, Berlin (East Germany). Inst. fuer Kosmosforschung.
MAGNETIC CAVITY FORMATION AT COMET HALLEY AND AT THE AMPTE LI RELEASE
K. Sauer and K. Baumgaertel *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 113-118 Original contains color illustrations (For primary document see N88-21884 14-91)
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The formation of the magnetic cavity around Comet Halley is studied in a nonstationary quasi one-dimensional fluid model. Characteristic features of spatial density, velocity, and magnetic field profiles observed by Giotto can be reproduced. The same model is also used to simulate the AMPTE Li release in the solar wind where the characteristic dimensions are smaller than the ion gyro radii. In spite of the expected limited applicability of the one-fluid model, quantitative agreement for magnetic field and plasma density variations is found. ESA

N88-21899# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
PLASMA PHENOMENA IN THE VICINITY OF THE CLOSEST APPROACH OF VEGA-1, 2 SPACECRAFT TO THE COMET HALLEY NUCLEUS **c75**
V. M. Balebanov, K. I. Gringauz, and M. I. Verigin *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 119-124 (For primary document see N88-21884 14-91)
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The plasma phenomena observed on board VEGA-1 and -2 spacecraft inside the cometary plasma region are summarized and their nature is discussed. The observed quasi-periodic modulation

of the heavy ion density in this region could be explained by the development of the large-scale instability connected with the cyclotron resonance of ions with Alfven oscillations. The occurrence of 1 keV electrons during VEGA-2 flyby could be a signature of sporadic magnetospheric substorms in the cometary atmosphere. Plasma and magnetic field observations near VEGA-1 closest approach to the nucleus give evidence of super-Alfvenic cometary plasma acceleration initiated by interaction of two portions of different polarity magnetic fields. ESA

N88-21900# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Astrophysik.
TIME DEPENDENT MHD MODELS FOR THE COMETARY MAGNETOSPHERE
M. Schmidt-Voigt *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 127-131 (For primary document see N88-21884 14-91)
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Three dimensional MHD models for the comet-solar wind interaction are presented. The results are generally in fairly good agreement with those of other authors. A difference from Fedder et al., (1983) is found in the flattening of the ion tail which is the main reason for discrepancies in the simulation of time dependent effects due to discontinuities in the solar wind magnetic field. The models cannot reproduce streamers or tail rays by this mechanism. Instead a tail condensation with a 90 deg switch of the field is found. ESA

N88-21901# Saint Patrick's Coll., Maynooth (Ireland). Dept. of Experimental Physics.
ENERGY SPECTRA OF PICK-UP IONS RECORDED DURING THE ENCOUNTER OF GIOTTO WITH COMET HALLEY
S. McKenna-Lawlor, B. Wilken, P. Daly, W.-H. Ip, E. Kirsch, A. Coates, A. Johnstone, A. Thompson, D. OSullivan, and K.-P. Wenzel (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 133-137 (For primary document see N88-21884 14-91)
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Particle data secured aboard Giotto by the energetic particle experiment at energies over 60 keV and by the JPA implanted ion sensor at energies over 2 keV are combined and composite energy spectra plotted for locations upstream of the bow shock, at the bow shock crossing and in the down-stream region. From a comparison of these data with theoretical energy spectra for water group ions which take into account the effect of adiabatic compression in the cometary accretion flow and assume varying degrees of scattering by hydromagnetic waves, it is found that a reasonable qualitative fit to the energy spectrum is obtained upstream of the shock if it is assumed that the mean free path corresponding to random scattering by Alfven waves is of the order of 30 gyroradii. An enhanced level of stochastic acceleration must be assumed in the turbulent region immediately downstream of the shock in order to adequately fit the observations. ESA

N88-21902# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
STOCHASTIC ACCELERATION OF COMETARY IONS: THE EFFECTS OF COMPOSITION AND SOURCE STRENGTH DISTRIBUTIONS
W.-H. Ip and W. I. Axford *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 139-144 (For primary document see N88-21884 14-91)
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It is suggested that detections of energetic heavy ions by spacecraft at large distances from Comet Halley may indicate the ionization and subsequent stochastic acceleration of a population of cometary neutral particles with streaming velocity much greater than 1 km/sec. The production of the fast neutrals might be due to photodissociation of the CO and CO2 molecules in the coma as well as the dissociative electron recombination of the CO(+) and CO2(+) ions in the cometary ionosphere. A simple model calculation of stochastic second-order Fermi acceleration also suggests that the production rate of the fast neutral component with velocity of the order of 7 to 10 km/sec should be 0.001 that of the total gas production during the VEGA encounter with Comet Halley. ESA

N88-21903# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
OBSERVATION OF ENERGETIC PARTICLES (E GREATER THAN 30 keV) BY THE GIOTTO EXPERIMENT EPA IN THE MAGNETIC CAVITY OF COMET HALLEY
E. Kirsch, S. McKenna-Lawlor, D. OSullivan, A. Thompson (Dublin Inst. for Advanced Studies, Ireland), and P. W. Daly *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 145-148 (For primary document see N88-21884 14-91)
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The Energetic Particle Analyzer EPA/EPONA onboard the Giotto S/C detected on 14 March, 1986 in the magnetic cavity of Comet Halley energetic ions with energies greater than 3.5 MeV as well as electrons greater than 300 keV. Between the forward and backward viewing telescopes an anisotropy ratio in the count rates of 2:1 is observed which results from energetic ions since neutral particles should not be detectable. The energetic ions are quasi trapped and can exceed the cavity due to their large gyroradii whereas electrons are more confined inside the contact surface. It is suggested that ions and electrons are accelerated by field line merging processes which seem to be possible at the sunward side of the pile-up region. Fermi acceleration of ions inside the cavity by multiple scattering processes and the entry of energized pick-up ions from the cometosheath region into the cavity must be considered. ESA

N88-21904*# Texas Univ., Austin. Dept. of Astronomy.
THE RELATIONSHIP BETWEEN LOW ACTIVITY COMETS AND MORE ACTIVE COMETS
A. L. Cochran, J. R. Green, and E. S. Barker *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 151-156 Sponsored by NASA, Washington (For primary document see N88-21884 14-91)
(Grants NGR-44-012-152; NSF AST-84-18196)
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Low activity comets were observed to see if they are normal, or if they show intrinsic differences. The comets were selected because they have no C2 or C3 emissions and sometimes no emissions were detected at all. It is shown that the low activity comets are intrinsically different from normal comets in that they are depleted in C2 and C3 relative to the observed CN, or that they are without any emissions at small heliocentric distances. Possible causes for the differences between the two groups of comets are suggested. Observational effects are discounted, since the same observational set-up and reduction procedure was used in all cases. Discrepancies may be due to differences at the time of formation, or during evolution, or a combination of both. ESA

N88-21905*# Howard Univ., Washington, D. C. Dept. of Chemistry.
THE PHOTOCHEMISTRY OF SOME POSSIBLE COMETARY CN PARENT SPECIES
Joshua B. Halpern *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 159-162 Sponsored by NASA, Washington (For primary document see N88-21884 14-91)
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Laboratory work on the photochemistry of HC3N, C4N2, and CH3CN in relation to their possible role as CN parent molecules in comets is discussed. Photodissociation of HC3N, photolysis of C4N2, and quantum yields of excited CN(B) and CN(A) radicals from the VUV photolysis of CH3CN are considered. ESA

N88-21906*# Southwest Research Inst., San Antonio, Tex.
EVIDENCE FOR FIRST POLYMER IN COMET HALLEY: POLYOXYMETHYLENE

W. F. Huebner, D. C. Boice, C. M. Sharp, A. Korth, R. P. Lin, D. L. Mitchell, and H. Reme (Centre d'Etude Spatiale des Rayonnements, Toulouse, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 163-167 (For primary document see N88-21884 14-91)
(Contract NASw-3375; Grants BMFT-01-OF-85057; CNES-1212)
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The RPA2-Positive Ion Cluster Composition Analyzer (PICCA) on the Giotto spacecraft detected 5 mass peaks with regular spacing of 15 amu up to approximately 120 amu. Starting at 45 amu, the peaks decrease in intensity with increasing mass. Within their half-width they are in good agreement with dissociation products of formaldehyde polymer (POM). A production sequence in which cosmic radiation formed POM from water and carbon monoxide on grains that were aggregated into cometesimals is suggested. Other polymers, possibly containing CN, may also exist. Observations suggest that at least some of the H-, C-, and O-containing dust particles detected by the Particle Impact Analyzer (PIA) on board the Giotto spacecraft and its equivalent on the VEGA-1 and -2 spacecraft contain POM. The properties of POM are consistent with many of the unexpected observations in the coma. ESA

N88-21907# Observatoire du Pic-du-Midi, Bagneres de Bigorre (France).
POLARIZATION OF MOLECULAR FLUORESCENCE BANDS IN COMETS: RECENT OBSERVATIONS AND INTERPRETATION
J. F. LeBorgne and J. Crovisier (Observatoire de Paris-Meudon, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 171-175 (For primary document see N88-21884 14-91)
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The theory of polarization of fluorescence emission and its application to cometary molecules are reviewed. Special consideration is given to OH: it is predicted that the linear polarization of its near-UV band depends on the comet heliocentric velocity and is small, due to the presence of both directions of polarization in individual lines. Theoretical results are compared with polarization observations of the CN, C2, C3, and OH bands in P/Halley. The influence of fluorescence anisotropy in the modeling of molecular spectra is discussed. ESA

N88-21908*# Sao Paulo Univ. (Brazil). Inst. of Astronomy and Geophysics.
PHOTODISSOCIATION LIFETIMES OF CH AND CD RADICALS IN COMETS
P. D. Singh and A. Dalgarno (Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 177-179 Sponsored in cooperation with CAPES (For primary document see N88-21884 14-91)
(Grants NsG-7421; Processo-84/1261-8)
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The rates of photodissociation of the CH radical from absorption of solar radiation are calculated to lie between 0.00416 and 0.0267/sec for heliocentric velocities between -42 and 42 km/sec at 1 AU from the Sun. For CD, the corresponding rates lie between 0.00433 and 0.0131/sec. The v'=0 level of the C2 sigma(+) is the main channel of CH as well as CD dissociation and, in each case, contributes over 77 percent of the total dissociation. The CH and CD radicals may be detectable in comets through absorption lines of the C2 sigma(+) - X2Di(r) electronic bands near 3143.2 and 3142.1 A, respectively. ESA

N88-21909# Catania Univ. (Italy). Ist. di Astronomia.
PHOTOMETRY OF P/HALLEY (1982I): IS WHAT WE HAVE LEARNED USEFUL FOR OTHER COMETS?
F. A. Catalano, G. A. Baratta, and G. Strazzulla *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 181-184 (For primary document see N88-21884 14-91)
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Photometric observations of P/Halley obtained before and after its passage at perihelion are presented. Gas (CN, C2, C3) and dust production rates and their variations with the solar distance are evaluated. It is shown that the results are consistent with a nucleus whose sublimation is regulated by a dark (polymer-like) material. The ejected dust seems also to contain absorbing material. Comparison of production rates of CN with those of HCN supports the hypothesis that HCN is a major parent species of CN. ESA

N88-21910# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
WATER VAPOR AND HYDROXYL DISTRIBUTIONS IN THE INNER COMA OF COMET HALLEY MEASURED BY THE VEGA-2 THREE CHANNEL SPECTROMETER TKS
V. A. Krasnopolsky, A. Yu. Tkachuk, G. Moreels, and M. Gogoshev (Bulgarian Academy of Sciences, Stara Zagora.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 185-190 (For primary document see N88-21884 14-91)
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Measurements of the Halley H2O 1.38 micron band on March 9, 1986, demonstrate that water vapor is ejected in a cone of (40 + or - 10) deg in the sunward direction with a total production rate of (8 + or - 2) times 10 to the 29th power/sec. Water vapor jets are seen up to 1000 to 2000 km. Gas and dust velocities in the observed jet are 0.85 + or - 0.15 and 0.55 + or - 0.05 km/sec, respectively. Measurements of the OH 309 nm band are reproduced by a model which takes into account the position of the instrument inside the coma, the asymmetry of the coma, its finite optical depth, the prompt excitation of the OH(A) state via the photolysis of water vapor, and the saturation effect. Total production rate of OH is also (8 + or - 2) times 10 to the 29th power/sec. The OH parent scale length is 40,000 at 1 AU; the ratio of OH number densities measured in the sunward direction to those in transverse direction equals 2. ESA

N88-21911# Vrije Universiteit, Brussels (Belgium).
NARROW-BAND PHOTOMETRY OF COMET P/GIACOBINI-ZINNER AT THE TIME OF ICE ENCOUNTER
C. Sterken and J. Manfroid (Liege Univ., Belgium) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 191-194 Sponsored by NFWO/National Fund for Scientific Research, Brussels, Belgium (For primary document see N88-21884 14-91)
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Narrowband multidiaphragm photometry of comet Giacobini-Zinner, obtained shortly after ICE passed behind the comet's nucleus is summarized. Derived fluxes are presented, and Haser model production rates are given for each night data. The comet appears to be an exception to the production rate-heliocentric distance relation. ESA

N88-21912# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
CCD-OBSERVATIONS OF GAS AND DUST JETS IN THE COMA OF COMET HALLEY
C. B. Cosmovici, P. Mack, G. Schwarz, A. Craubner, and W.-H. Ip (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 195-207 Original contains color illustrations (For primary document see N88-21884 14-91)
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The CCD-observations of Comet Halley at a 192 cm telescope with International Halley Watch (IHW) filters for near nucleus studies and special narrow band filters are reported. A ring masking technique was applied to visualize gas and dust jet behavior during 5 days of observation around the Giotto flyby. Whereas the detection of CN jets is unambiguous, C2, C3, CO(+), and H2O(+) jets are still affected by dust contamination. ESA

N88-21913*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPATIAL DISTRIBUTION OF O(SUPRA 1D) FROM COMET HALLEY
F. L. Roesler, F. Scherb, K. Magee-Sauer, J. Harlander, R. J. Reynolds (Wisconsin Univ., Madison.), and R. J. Oliversen *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 217-222 (For primary document see N88-21884 14-91)
(Grant NAGw-695)
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Images of Comet Halley in (OI)6300A emission obtained using a 150 mm Fabry-Perot spectrometer in the imaging mode were combined with spectra taken in the scanning mode to deduce the distribution of cometary O(1D) within a 10 arc min field of view centered on the comet head. The 10 km/sec bandpass of the system allows the distribution to be measured with little contamination from airglow O(1D) and cometary NH2 lines in the nearby spectrum. The results are modeled to provide photodestruction scale lengths for cometary H2O and OH, the predominant parents of O(1D). Results are compared with other experimental and theoretical results. ESA

N88-21914# Central Research Inst. for Physics, Budapest (Hungary).
DISTRIBUTION OF NEUTRAL GAS MOLECULES AT LARGE DISTANCES FROM HALLEY'S COMET
G. Erdos and K. Kecskemety *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 223-227 (For primary document see N88-21884 14-91)
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Ballistic trajectories of neutral gas molecules around Halley's comet are traced in the cometocentric frame up to large distances from the comet. It is shown that the density of gas significantly deviates from what is expected if the orbital motion of comet is disregarded. The outflow velocity of gas, required to reach spacecraft VEGA-1, ICE, and Sakigake, is calculated. The trajectory calculation suggests that observations carried out far from Halley's comet are inconsistent with low outflow velocity. ESA

N88-21915# Tokyo Univ. (Japan). Inst. of Space and Astronomical Science.
HALLEY'S ENVIRONMENTS BY THE JAPANESE SUISEI SPACECRAFT
M. Shimizu *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 229-232 (For primary document see N88-21884 14-91)
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The atomic and ionic environments of Comet Halley obtained by the Suisei spacecraft are reviewed. Determination of rotational period 52.9 + or - 0.1 hr; detection of organic hydrogen atom and related biological aspects; and ion density observations in the plasma environment are discussed. ESA

N88-21916# Observatoire de Paris-Meudon (France).
THE ROLE OF WATER IN THE THERMAL BALANCE OF THE COMA
D. Bockelee-Morvan and J. Crovisier *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 235-240 (For primary document see N88-21884 14-91)
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The efficiency of photolytic heating in cometary atmospheres is investigated by a Monte Carlo simulation. Radiative cooling by water is treated with the excitation model of Bockelee-Morvan (1987) which includes radiative transfer. Solutions for the expansion velocity and temperature profiles of a dust-free coma are compared with observations of P/Halley. Close agreement is found. The gas expansion velocity is peculiarly sensitive to model assumptions. A heating source as strong as the dust infrared heating postulated by Marconi and Mendis (1986) would accelerate the gas at velocities greater than 1.2 km/sec in the inner coma, in conflict with the velocities observed in situ. Similarly, large gas initial temperatures would yield too large gas velocities: this suggests that the gas emission regions of the nucleus are disconnected from the hot (400 K) nucleus regions observed by the imaging channel of the VEGA IKS instrument. ESA

N88-21917# Observatoire de Paris-Meudon (France).
RECENT OBSERVATIONS OF THE OH RADIO LINES IN COMETS
P. Colom, D. Bockelee-Morvan, G. Bourgois, J. Crovisier, and E. Gerard *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 241-245 (For primary document see N88-21884 14-91)
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The 18 cm OH lines in comets P/Halley 1982i and C/Wilson 1986l were observed with a radio telescope. Time variations of the signal and an attempt to find out periodic variability are discussed. Variation of the line shapes with heliocentric distance and gas production rate are considered. On several occasions, the line shapes are narrow, which puts constraints on both the parent expansion velocity and the OH ejection velocity at photodissociation. ESA

N88-21918# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
A MODEL OF THE ANISOTROPIC STRUCTURE OF THE NEUTRAL GAS COMA OF A COMET
N. I. Koemle and W.-H. Ip (Academy of Sciences, Graz, Austria) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 247-254 Original contains color illustrations (For primary document see N88-21884 14-91)
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Observations of Comet Halley indicating a marked asymmetry between the sunward and the tailward-directed part of the neutral gas coma are discussed. This asymmetry seems not to be restricted to the near-nucleus region but persists out to distances of at least several 10,000 km, according to infrared spectroscopic observations. Model calculations simulating the observed asymmetries from a gasdynamical point of view are presented. Conditions where outgassing anisotropies at the nucleus could be maintained out to large distances are considered. Results from a time-dependent computation show the influence of a short, localized gas outburst event on the cometary coma. The measured anisotropy of the water vapor content may be related to such an event. ESA

N88-21919# Observatoire de Besancon (France).
PROFILES OF THE MAJOR GAS EMISSIONS AND DISTRIBUTION OF DUST PARTICLES IN THE INNER COMA (0 TO 10,000 km) OF COMET HALLEY
J. P. Parisot, J. M. Zucconi, M. C. Festou, G. Moreels, J. Clairemidi, J. L. Bertaux, J. E. Blamont, M. Herse, V. A. Krasnopolsky, and V. I. Moroz (Academy of Sciences, USSR, Moscow) et al. *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 255-262 Prepared in cooperation with Bulgarian Academy of Sciences, Stara Zagora (For primary document see N88-21884 14-91)
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Spectroscopic observations of the inner coma of Comet Halley in the visible range were obtained on March 9, 1986 by the TKS spectrometer on VEGA-2. The dust distribution spatial structure indicates that solid particle ejection is restricted inside a cone whose axis lies in the direction of the Sun. This is believed to be due to the fact that the path of the observed particles is not affected enough by collisions with neutral molecules to populate the entire space around the nucleus. The distribution of gases around the nucleus is isotropic, even near the nucleus where it is supposed to be released from well defined active areas. The observed distributions of the CN, C2, and C3 radicals are fully compatible with a one-step production chain. The OH profiles seem to be anomalous below distances of the order of 600 km, which

can be explained by taking into account the strong absorption of the solar flux by water vapor that should occur there. ESA

N88-21920# Notre Dame Univ., Ind.
ANALYSIS OF THE COMA OUTBURST OF COMET HALLEY, MARCH 24 TO 25 (UT), 1986
T. W. Rettig, J. R. Kern, R. Ruchti, B. Baumbaugh, A. E. Baumbaugh, K. L. Knickerbocker, and J. Dawe (Australian National Univ., Coonabarabran.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 265-269 Sponsored in part by NSF; Notre Dame Univ.; the Planetary Society; the National Geographic Society; and United Airlines (For primary document see N88-21884 14-91)
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Observations using a fast CCD and custom built video data acquisition system at the Nasmyth focus of a 2.3 m telescope produced digitized images of Comet Halley. Nightly variations in inner coma brightness and shape are noted. On March 25, 1986, (UT), an overall brightening and antisunward jet was recorded continuously over several hours and is shown to be consistent with the increased activity recorded just prior to these observations. The outburst and resulting jet produced a large integrated intensity increase, and the rotation rate is estimated from the antisunward jet. ESA

N88-21921# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
DUST COMA MORPHOLOGY OF COMET HALLEY DURING THE GIOTTO ENCOUNTER
W.-H. Ip, C. B. Cosmovici, P. Mack, H. Craubner, and G. Schwarz (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 271-275 Original contains color illustrations (For primary document see N88-21884 14-91)
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The CCD images of Comet Halley obtained during the time interval of Giotto encounter on March 14, 1986, were analyzed by applying image enhancement techniques. The anisotropic structures of the dust coma so revealed provide additional information on the dust emission pattern. Results suggest that CN jet formation did not necessarily coincide with the first emission of the dust spike. ESA

N88-21922*# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany).
COMETARY MHD AND CHEMISTRY: APPLICATION TO HALLEY
R. Wegmann, H. U. Schmidt, W. F. Huebner (Southwest Research Inst., San Antonio, Tex.), and D. C. Boice *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 277-282 Original contains color illustrations Sponsored by NASA, Washington (For primary document see N88-21884 14-91)
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An MHD and chemical comet coma model was applied to the plasma flow, the magnetic field, and the ion abundances in Comet Halley. By alternating iterations between axisymmetric models with detailed chemistry and three dimensional models with rigorous account of the Lorentz forces, a consistent description of the plasma flow and chemical evolution in the ionized cometary coma is derived. Models appropriate to Comet Halley in which the magnetized plasma flow, the bow shock, the magnetic cavity of size 5000 km, and the model ion abundances at 1500 km and 6000 km from the nucleus are in qualitative agreement with the Giotto data were derived. The axisymmetric model correctly shows the three groupings of ions at each distance. The model abundances for the light ions, up to 21 amu, are in very good agreement with the 1500 km observations. The comparison becomes worse at higher molecular masses and greater distances from the nucleus. ESA

N88-21923# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
GAS COMA OF COMET GIACOBINI-ZINNER: EMISSION FROM GRAINS
Max K. Wallis, Nigel P. Meredith, and David Rees (University Coll., London, England) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 283-287 Sponsored by the United Kingdom Science and Engineering Research Council (For primary document see N88-21884 14-91)
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Comet Giacobini-Zinner was observed from 26 Aug. to 12 Sept., 1985 from the ground. Images in CN, C2, and OI show circular isophotes, interpreted as due to daughter molecules emitted from parent molecules or grains having lower source speeds, rather than emission from day and night sides of the nucleus. Parent length scales derived for C2 and CN are compatible with measurements for Comets Halley and Wilson. In the CN images, Greenstein effects give the principal sun-tail anisotropies, but residual sunward bias due to sun-side production is detected. The OI images show isophotes close to circular, and integral profiles show a central source region of scale 2000 km. Its parent (assumed to be H2O) is being released from grains on this scale and proceeding in free molecular flight to populate the sunward and tailward comas uniformly. The short parent scale for CN and C2 could correspond to the scale for release from CHON grains, as hypothesized too for Halley. ESA

N88-21924# Observatoire de Strasbourg (France).
OBJECTIVE-PRISM SPECTRA OF THE COMETS HONDA (1968 e), HARTLEY-GOOD (1985 l) AND HALLEY
A. Florsch, J. Marcout, A. Laval, and G. Traversa (Observatoire de Haute Provence, Forcalquier, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 289-292 (For primary document see N88-21884 14-91)
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Several spectra were taken of the Comets Honda (1968 e), Hartley-Good (1985 l) and Halley with a Fehrenbach objective-prism, and compared in the field ranging from 380 to 500 nm. The main images of the coma in this limit are those given by C2, C3, and CN. No fundamental differences appear. ESA

N88-21925# Observatoire de Besancon (France).
COLOR FLUCTUATIONS IN THE INNER COMA OF COMET HALLEY AS MEASURED FROM VEGA-2
J. Clairemidi, G. Moreels, J. L. Bertaux, M. Herse, V. A. Krasnopolsky, V. I. Moroz (Academy of Sciences, USSR, Moscow), M. Gogoshev, and Tz. Gogosheva *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 293-301 Sponsored by CNES, France and the Besancon-Franche-Comte Univ., France (For primary document see N88-21884 14-91)
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During the last half-hour before closest approach of VEGA-2 to Halley, the three-channel spectrometer scanned a triangular field of view of sides 4000 and 2000 km with a summit located at 200 km from the nucleus. Spectra obtained show that the dust continuum gradually increases with decreasing impact parameter. A data processing method based on the calculation of color indexes is used to compare the color of the dust continuum from one place to another in the field of view. Pixel-to-pixel ratios of spectra give evidence of a spatial modulation of the color. Spatial mappings of the blue and red color indexes show color fluctuation present some degree of periodicity with a wavelength of 300 to 400 km. These charts are correlated with intensity gradients of the OH emission and with the intensity of CN and CO2(+). The best correlation is obtained between the charts of the blue color index and of the CO2(+) emission. Observations are interpreted in terms of a modulated triggered emission mechanism at the surface of the nucleus or in terms of disintegration of conglomerates of large grains. Enhancements of the blue color index might reveal either

an excess of small submicron particles producing Rayleigh scattering or the presence of icy grains having a blue albedo.
ESA

N88-21926# Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
NEW PROPERTIES OF COMETARY DUST
E. Gruen, L. Massonne, and G. Schwehm (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 305-314 (For primary document see N88-21884 14-91)
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Previously unknown phenomena involving dust and new properties of cometary matter observed by the space probes to Comet Halley as well as by Earth-based observations are reviewed. Observation of the coma boundaries for particles in the mass range 10 to the minus 16th to minus 10th power g is mostly compatible with optically absorbing particles. The observed variability of the dust flux of a factor 3 to 5 is due to spatially and time varying dust emission on the nuclear surface. Because of the flat shape of the cumulative mass distribution, the total dust mass production critically depends on the mass of the largest particle emitted from the nucleus which escaped detection by the space probes. Therefore the dust to gas mass ratio cannot be accurately assessed. A value of 1.5 seems to be an upper limit for this ratio.
ESA

N88-21927*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANISOTROPIC EMISSION FROM COMETS: FANS VERSUS JETS. 1: CONCEPT AND MODELING
Z. Sekanina *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 315-322 (For primary document see N88-21884 14-91)
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Jets and fans of dust ejected from discrete emission sources on the sunlit side of comet nuclei were studied. Computer-generated images of these features illustrate the diversity of patterns that can be explained by varying the position of the spin axis, rotation period, location and extent of the active area, and the ejecta's dynamical constants for a given Sun-Earth-comet geometry. It is shown that an emission fan is generated by rotation of a high-latitude source about the spin axis of the nucleus with a relatively high obliquity, but that the fan's formation is rather insensitive to the rotation period. It appears that at least for comets with perihelia well outside the Earth's orbit, the position angle of a fan's observed axis virtually coincides with the projected direction of the spin axis, thus constraining the spatial orientation of the latter.
ESA

N88-21928*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ANISOTROPIC EMISSION FROM COMETS: FANS VERSUS JETS. 2: PERIODIC COMET TEMPEL 2
Z. Sekanina *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 323-336 Original contains color illustrations (For primary document see N88-21884 14-91)
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The position of the rotation axis of P/Tempel 2 is constrained by projected orientations of the comet's sunward fan-like coma extension during 9 apparitions. The approach employed is based on the emission-cone concept formulated for a continuous (or quasi-continuous) collimated flow of dust ejected from discrete active regions on a rotating nucleus. The results show that the observations can be satisfied by assuming an invariable position of the pole, although this is not necessarily the only solution. The derived obliquity of 54 deg and the latitude of +60 deg for the southernmost boundary of the active source imply that the region experiences a polar day for 5 months about perihelion and a polar night for over 3 yr approximately centered on the aphelion point. Combining these results with scattered photometric and spectrophotometric information on the comet at large heliocentric distance, the outbursts observed near 3 AU are attributed to intermittent activity from the region shortly prior and following the polar night.
ESA

N88-21929# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
COMET P/HALLEY'S NEAR-NUCLEUS JET ACTIVITY
N. Thomas and H. U. Keller *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 337-342 Original contains color illustrations (For primary document see N88-21884 14-91)
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The Halley Multicolor Camera (HMC) on Giotto returned high resolution images of the nuclear and near-nuclear regions in March 1986. The images transmitted in the seconds prior to closest approach allow a detailed study of an active region down to a resolution of 50 m per pixel. Variations in activity within the main emission are observed and results which indicate deviations from an r sup -1 law to a less steep profile near the source region are presented. The results provide constraints on models of cometary jet activity.
ESA

N88-21930# Central Research Inst. for Physics, Budapest (Hungary).
DUST PHOTOMETRY IN THE NEAR NUCLEUS REGION OF COMET HALLEY FROM VEGA-2 OBSERVATIONS
I. Toth, K. Szego, and A. Kondor *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 343-347 (For primary document see N88-21884 14-91)
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The images obtained by VEGA-2 spacecraft during the encounter with Halley's comet show interesting jet structures. A semi-empirical method for the special near nucleus conditions to estimate the dust and gas contribution to brightness distribution is presented. Jets were analyzed using this modified Haser model.
ESA

N88-21931# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
DYNAMICS OF CHARGED SUBMICRON GRAINS IN HALLEY'S COMA
Max K. Wallis and Mohammed H. A. Hassan (International Centre for Theoretical Physics, Trieste, Italy) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 351-353 (For primary document see N88-21884 14-91)
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Two characteristics of the smallest (femtogram) grains in Comet Halley's coma are ascribed to electrical forces on them, namely, their penetration to large distances with any remnants of envelopes eliminated, and the dispersion with grain size of dust jets in the inner coma. This is shown quantitatively for the data from VEGA-2, when the magnetic field was at a suitable orientation. It is inferred that grain potentials in the inner coma are a few V negative, appropriate to a hot (eV) halo to the electron distribution in addition to the main cool core.
ESA

N88-21932# Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
COMPOSITION OF COMETARY DUST PARTICLES
P. Hsiung and J. Kissel *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 355-358 (For primary document see N88-21884 14-91)
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About 120 mode O spectra from the Giotto dust impact analyzer, which give direct access to mass numbers, were analyzed, including the composition of single grains and a global elemental composition. The variation of elemental composition with grain mass shows clearly a dependance between C, N, and H on one side, and between Si and O on the other. These two groups also

do not have the same spatial distribution (distance from the comet). ESA

N88-21933# Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
ISOTOPIC COMPOSITION OF HALLEY DUST
M. Solc, V. Vanysek (Karlova Univ., Prague, Czechoslovakia), and J. Kissel *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 359-362 (For primary document see N88-21884 14-91)
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On the basis of VEGA PUMA 1 mode O mass spectra of Halley solid grains, isotopic patterns are found for C, O, Mg, S, Fe (and Cl, probably not of cometary origin). While isotopic abundances calculated for O, Mg, S, Cl and Fe are near to the terrestrial values, carbon isotope ratio C12/C13 varies from 30 to several hundreds. Temporal and local carbon isotope ratio dependence along the path of VEGA-1 is given. ESA

N88-21934*# New Mexico Univ., Albuquerque. Dept. of Geology.
COMETARY EVOLUTION: CLUES FROM CHONDRITIC INTERPLANETARY DUST PARTICLES
F. J. M. Reitmeijer and I. D. R. Mackinnon *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 363-367 (For primary document see N88-21884 14-91)
(Grant NAG9-160)
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Cometary and interplanetary dust particles (IDP) are compared, and the mineralogical evolution of comet nuclei is discussed. Chondritic IDP have properties consistent with properties expected for cometary dust. The complex and varied mineralogy of these particles may indicate mineral alteration processes that occur in comet nuclei. Depending on the thermal budget of a comet, the upper few meters of nucleus material may maintain temperatures within regimes of hydrocryogenic (200 to 237 K) and low-temperature aqueous (274 to 400 K) alteration. Thus, layer silicates, carbonates, and sulfates may be important components of cometary dust and, correspondingly are common constituents of chondritic IDPs. Alteration of comet starting materials may be a common occurrence, and depends on the specific physical and chemical properties of each individual comet. ESA

N88-21935# Observatoire de Paris-Meudon (France).
ON THE INTERPRETATION OF THE 3 MICRON EMISSION FEATURE IN THE SPECTRUM OF COMET HALLEY: ABUNDANCES IN COMET HALLEY AND IN INTERSTELLAR MATTER
Th. Encrenaz, J. L. Puget, J. P. Bibring, M. Combes, J. Crovisier, C. Emerich, L. dHendecourt, and F. Rocard (Paris-Sud Univ., Orsay, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 369-376 (For primary document see N88-21884 14-91)
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Comet Halley and interstellar medium visible spectra are compared. Main cometary features are seen around 3.28 micron and 3.37 micron, with no associated feature beyond 6 micron. These features are interpreted as resonance fluorescence by the solar radiation field of hydrocarbon molecules, in the saturated and the nonsaturated (possibly aromatic) form. The total number of carbon atoms in these hydrocarbons is 30 percent of H2O in Halley. This number is used to derive the relative abundances of H:C:N:O in Comet Halley. The result is H:C:N:O equals 1.39:0.39: less than 0.08:1.00, to be compared with the value of H:C:N:O in dense clouds. This comparison suggests that in Halley 40 percent of C and at least 50 percent of N are trapped in cometary grains. The agreement between the derived compositions of interstellar dust and cometary material suggests an analogy in the nature of the original material at the time of the comet's formation, as does the analogy found in the irradiation processes of ices observed in the interstellar medium and in Halley. ESA

N88-21936# Kent Univ., Canterbury (England). Unit for Space Sciences.
P/HALLEY DUST COMA: GRAINS OR ROCKS?
S. F. Green, J. A. M. McDonnell, C. H. Perry, S. Nappo, and J. C. Zarnecki *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 379-384 (For primary document see N88-21884 14-91)
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The Giotto Dust Impact Detection System (DIDSY) and Particle Impact Analyzer (PIA) measured the dust flux in the coma of P/Halley for masses heavier than 10 to the minus 19th power kg. Mass distribution is discussed, emphasizing large particles in the mg range. Discrete DIDSY data for 10 to the minus 9th to minus 5th power kg show a mass distribution index (alpha) much smaller than 0.85 found for 10 to the minus 13th to minus 9th power kg. The deceleration of the spacecraft from impacts also requires a large particle flux with mean alpha = 0.54 from 3 times 10 to the minus 9th power to 0.0006 kg. The projected area of grains in the coma, which partly determines the observed brightness of the coma, is shown to be dominated by small (1 to 10 micron) and large (at least mm) particles, whereas the mass is totally dominated by the large grains. Evidence for these large grains in groundbased observations is discussed. The mass distribution of particles emitted from the nucleus is also dominated by these large grains, and therefore the total dust production rate and gas:dust ratio are critically dependent on the mass of the largest particle leaving the nucleus. ESA

N88-21937# Academy of Sciences, Potsdam (East Germany). Zentralinst. fuer Astrophysik.
THE STRIAE IN THE DUST TAILS OF GREAT COMETS: A FORMAL COMPARISON OF THE GOODNESS OF FIT BY VARIOUS THEORIES, AND A NEW PROPOSAL
H.-E. Froehlich, P. Notni, and W. Thaenert *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 385-389 (For primary document see N88-21884 14-91)
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The motion of the striae in the dust tails of Comets Mrkos 1957 V and West 1976 VI is checked to see whether it corresponds to the predictions of the high-speed ejection theory or to a special two-step kinematical sequence. It is found that only the two-step kinematics can explain all striae in both comets. The parent clouds (first step) are found to have low lateral velocity dispersion and unusual high acceleration; magnetic confinement and plasma interaction may be the cause. The first-step clouds, comprising comoving particles, may originate in regions where dust is optically thick (tau = 1). Shadowing effects then cause a radial confinement of the cloud. ESA

N88-21938*# Chicago Univ., Ill. Enrico Fermi Inst.
THE ORIGIN OF LOW MASS PARTICLES WITHIN AND BEYOND THE DUST COMA ENVELOPES OF COMET HALLEY
J. A. Simpson, D. Rabinowitz, A. J. Tuzzolino, L. V. Ksanfomality, and R. Z. Sagdeev (Academy of Sciences, USSR, Moscow) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 391-397 Sponsored in part by the Academy of Sciences, Moscow, USSR (For primary document see N88-21884 14-91)
(Contract NASw-3959)
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Measurements from the Dust Counter and Mass Analyzer (DUCMA) instruments on VEGA-1 and -2 revealed unexpected fluxes of low mass (up to 10 to the minus 13th power g) dust particles at very great distances from the nucleus (300,000 to 600,000 km). These particles are detected in clusters (10 sec duration), preceded and followed by relatively long time intervals during which no dust is detected. This cluster phenomenon also occurs inside the envelope boundaries. Clusters of low mass particles are intermixed with the overall dust distribution throughout the coma. The clusters account for many of the short-term small-scale intensity enhancements previously ascribed to microjets in the coma. The origin of these clusters appears to be emission

from the nucleus of large conglomerates which disintegrate in the coma to yield clusters of discrete, small particles continuing outward to the distant coma. ESA

N88-21939# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Lab. de Physique Stellaire et Planetaire.
OPTICAL AND HYDRODYNAMIC IMPLICATIONS OF COMET HALLEY DUST SIZE DISTRIBUTION
J. F. Crifo *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 399-408 (For primary document see N88-21884 14-91)
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Using a specially developed radiative hydrodynamic code, the compatibility between the dust fluences recorded by detectors on Giotto and Vega, the rate of deceleration of the Giotto spacecraft encounter, and a set of pre and postperihelion spectra of Halley extending from near to far infrared wavelengths are examined. It is proposed that the average coma dust distribution is well represented by the envelope of those deducible from the fluences of the VEGA and Giotto probes. Implications of this suggestion are quantitatively investigated. ESA

N88-21940# Laboratoire d'Astronomie Spatiale, Marseille (France).
SIMILARITY AND DIVERSITY OF THE POLARIZATION OF COMETS
J.-M. Perrin and P. L. Lamy (Max-Planck-Inst. fuer Kernphysik, Heidelberg, West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 411-415 (For primary document see N88-21884 14-91)
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The polarization measurements of the dust coma of 10 comets including P/Halley were analyzed. Separation of the dust from the gas, emphasizing the value of the narrow-band and spectropolarimetric data, is outlined. Polarization curves are deduced, implying unambiguous differences in the physical properties of the cometary dust. The negative branch of polarization is discussed and intepreted as suggesting a rough surface for the grains. ESA

N88-21941# Observatoire de Paris-Meudon (France).
COMETARY GRAINS AND INTERPLANETARY DUST: A POLARIMETRIC SENSING
Audouin Dollfus *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 419-421 (For primary document see N88-21884 14-91)
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Physical properties of the solid grains ejected from the nucleus of comet P/Halley were studied by optical telescopic polarimetry. In the coma, the presence of a large number of fluffy aggregates made of very dark small particles is indicated. Such flakes are subjected to the Poynting-Robertson effect which reduces the major axis of their orbits, and they are progressively transported in the inner part of the Solar System. It is suggested that the fluffy aggregates known to produce the zodiacal light, and those collected as Brownlee particles in the upper atmosphere, originate directly as such from comets. ESA

N88-21942# Montreal Univ. (Quebec). Dept. de Physique.
THE DUST AROUND THE NUCLEUS OF COMET HALLEY
P. Bastien, L. Drissen, F. Menard, N. StLouis, and R. Nadeau *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 423-426 Sponsored by the Canadian Conseil de Recherches en Sciences Naturelles et en Genie (For primary document see N88-21884 14-91)
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The dust in the coma of P/Halley was studied by polarimetry in narrow band filters. Observations obtained before and after perihelion are discussed; the range covered in phase angle is 18 to 66 deg. The polarization vector is perpendicular to the scattering plane when the phase angle is greater than a critical value, and parallel to that plane otherwise. This value = 22 deg + or - 2 deg for P/Halley. The slope near the cross-over yields an albedo lower than 0.05. In the continuum, the polarization is mostly independent of wavelength before perihelion, but after perihelion it decreases slowly from the red to the blue. A depolarization is clearly observed in the emission bands, as expected. The data are best explained by single and multiple scattering on large (over 2 microns) dark, irregular grains. ESA

N88-21943# Kanazawa Inst. of Tech. (Japan).
VARIATION OF GRAIN PROPERTIES AT THE DUST OUTBURSTS
Tadashi Mukai, Sonoyo Mukai, and Sen Kikuchi (Tokyo Astronomical Observatory, Japan) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 427-430 (For primary document see N88-21884 14-91)
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Periodic fluctuations with time of visible polarization of Comet Halley were found. Higher polarization occurs simultaneously in the Lyman-alpha flash events reported by Suisei. By using the grain model, which can give a good agreement with the observed phase angle dependence of polarization, it is shown that in the coma within 10,000 km from the nucleus, an increase of total amount of grains by a factor of 1.5, plus enhancement of smaller grains with radii less than 0.1 micron by 1 order of magnitude in number, compared with those in a quiet time, explain the simultaneous appearance of higher polarization and brighter scattered light observed in Comet Halley during the dust outbursts. ESA

N88-21944# George Mason Univ., Fairfax, Va.
PARTICLES INJECTED BY COMETS
Fred S. Singer *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 433-434 (For primary document see N88-21884 14-91)
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Submicron sized particles released by comets into interplanetary (IP) space are discussed. Sensitive impact detectors on Explorer 46 satellite show large increases in flux during certain meteor streams. The total mass and lifetime of these particles were determined and their electric potential deduced. Space debris, which, in principle, could affect the observations, is shown to be unimportant. A more refined experiment on the Long Duration Exposure Facility (LDEF) to settle crucial problems ragarding IP particles is mentioned. ESA

N88-21945# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Astronomy.
ON ORBITS AND ASSOCIATION OF METEOR STREAMS WITH COMETS P/HALLEY AND P/ENCKE
V. Porubcan and J. Stohl *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 435-440 (For primary document see N88-21884 14-91)
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Mean orbits of meteor streams associated with Comet P/Encke, together with the dispersion of individual orbits and changes of the orbital elements across the streams are evaluated on the basis of precise photographic observations. Association of several minor showers with the streams is analyzed, applying stream membership D-criterion. The results are compared and inter-related to those obtained for other streams, especially those associated with P/Halley. Reality and origin of the whole meteoric complex, including the diffuse sporadic stream associated with P/Encke is discussed. On the basis of the orbital data alone it is impossible to come to the final conclusion whether the Taurid meteor complex was produced by a continuous outflow of particles from a large single parent body, or from a few closely associated smaller bodies with common origin. More investigation is needed on the orbital evolution of the streams and their potential parent bodies, as well as a complex examination of the orbits, radiants, and hourly rates of all the showers involved. ESA

N88-21946# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Astronomy.
THE EVOLUTION OF THE MASS DISTRIBUTION OF COMETARY PARTICLES
A. Hajduk and I. Kapisinsky *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 441-444 (For primary document see N88-21884 14-91)
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A model for the evolution of the mass distribution of particles ejected from Comet Halley is proposed on the basis of results of space experiments and ground based observations of Halley meteor showers. It is shown that the mass index of dust particles varies in the evolutionary process, following the diffusion of particles in the interplanetary medium. This is caused by the different efficiency of physical factors affecting the motion of particles from different mass range. The model is applicable to other comets with showers. ESA

N88-21947# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (West Germany).
THE NUCLEUS OF COMET HALLEY
H. U. Keller *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 447-454 Original contains color illustrations (For primary document see N88-21884 14-91)
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Comet nuclei, and particularly Giotto Halley Multicolor Camera (HMC) studies, are reviewed. The size of the nucleus of Comet Halley is considerably larger than required for the observed gas and dust production by unrestricted sublimation of water ice. The question whether the crust or mantle that covers large portions of the nucleus and prevents sublimation of the ice underneath is cohesive or regolith remains open. At least in one incidence, the VEGA-2 images reveal minor activity originating from the night side of the nucleus. On HMC images, there are five dust filaments pointing into the antisunward hemisphere. However they could be from the evening side of the nucleus. The sublimation leads to erosion of the surface. About 6 m of the active surface is lost during revolution. The mass of the nucleus derived from the nongravitational forces (10 to the 14th power kg) combined with its large volume leads to a very small density of 0.2 g/cc. ESA

N88-21948*# Ball Aerospace Systems Div., Boulder, Colo.
COMPARISON OF ACTIVE REGIONS ON THE NUCLEUS OF COMET HALLEY
H. J. Reitsema, W. A. Delamere, and F. L. Whipple *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 455-459 (For primary document see N88-21884 14-91)
(Contract NASw-3573; Grant NsG-7082)
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The images of the nucleus of Comet Halley returned by the Giotto spacecraft reveal a number of active regions on the surface, one of which is near the expected location of the rotation axis. This feature is larger and brighter than other source regions, suggesting that the mechanism which drives this source is also different. At this active region near the rotation pole the Sun is circumpolar for a significant portion of the solar encounter. Continuous solar insolation causes heating of the nucleus to greater depths and results in the unique properties of this source region. For example, the dust scattering in the antisolar regions around the nucleus is less from the polar region than from the region at the sunward end of the nucleus, consistent with spotty ejection of dusty mantle from the sunward tip and widespread activity in the polar region. ESA

N88-21949# Central Research Inst. for Physics, Budapest (Hungary).
RECONSTRUCTION OF THE ORIENTATION AND SHAPE OF THE NUCLEUS OF COMET HALLEY
K. Szego, A. Kondor, I. Toth, R. Z. Sagdeev, K. Wilhelm, and H. U. Keller (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany) *In* ESA, Proceedings of the International Symposium of on the Diversity and Similarity of Comets Sep. 1987 p 463-469 (For primary document see N88-21884 14-91)
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A modeling technique for the analysis of the imaging data of VEGA and Giotto was developed. The position of the small and big ends of the nucleus is obtained unambiguously for the different encounters. ESA

N88-21950# Astronomical Observatory, Uppsala (Sweden).
ESTIMATES OF MASSES, VOLUMES AND DENSITIES OF SHORT-PERIOD COMET NUCLEI
H. Rickman, L. Kamel, M. C. Festou, and Cl. Froeschle (Observatoire du Mont-Gros, Nice, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 471-481 (For primary document see N88-21884 14-91)
(Grants SWED-NSRC-F-FU-3271-107; SWED-NSRC-R-RA-3271-109)
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Masses of 29 short-period comets are estimated. By comparing nongravitational parameters with the jet forces expected from the gas production curves, an allowed mass range is calculated for each comet. The gas production curves were calculated from the visual light curves using Festou's correlation. These curves also give free-sublimating areas and by assuming a reasonable dust coverage the volumes and densities can be estimated, based on the statistics of nongravitational parameters as a function of dynamical age. Nothing definite can be said about the densities of individuals comets, except for P/Halley, but the approach leads to a statistical picture which supports the idea of cometary nuclei as highly porous objects. ESA

N88-21951# Warsaw Univ. (Poland). Dept. of Chemistry.
POROSITY AND FRACTALITY OF A COMETARY NUCLEUS
Bruno Lang *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 483-486 (For primary document see N88-21884 14-91)
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The bulk porosity of a cometary nucleus is explained as the fraction of its total volume equal to the void space as complementary to the cometary solid matter while responsible for its low bulk density. This void space is composed of two parts: one resulting from a loose open structure and the other distributed among abundant intergranular and intercrystalline meso-, micro- and ultramicrosized pores inside distinct mineral species. In terms of the differences in intrinsic and apparent densities, the volume of the pore space inside the involatile silicate and the volatile icy phases is 4.7 times 0.0001 cu m/kg and 9.0 times 0.0001 cu m/kg respectively. For the apparent density of the nucleus, 200 kg/cu m, the bulk porosity is 80.56 percent the contribution of the free volume being 79.44 percent of the total volume. The fractal structure of the analyzed nucleus was characterized by the fractal dimension near to 3.0 ESA

N88-21952# Academy of Sciences, Berlin (East Germany). Inst. fuer Kosmosforschung.
PROPERTIES OF THE NUCLEUS OF P/HALLEY
D. Moehlmann, M. Danz, and H. Boerner *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 487-492 Original contains color illustrations (For primary document see N88-21884 14-91)
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Surface structures of P/Halley, as seen on processed VEGA images, are discussed. The reality of these large-scale structures is confirmed. Based on the assumption that these surface structures are related to large-scale internal structures, it is concluded that cometary nuclei are grown by accretion of large km-sized building blocks. This implies that processes of cometary accretion (origin) were possible only in the outer regions of the solar system at distances of the present Oort cloud. ESA

N88-21953# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
CRUSTAL MODELS OF THE EVOLVING COMET NUCLEUS
M. K. Wallis and N. C. Wickramasinghe *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 495-499 (For primary document see N88-21884 14-91)
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Comet missions are shown to validate the two-phase surface model of Shul'man, except that loose grains are consolidated via physico-chemical and gas deposition into a coherent crust. This primarily organic crust is further consolidated by cooking in solar radiation, especially at peak temperatures around perihelion. The two surface phases of sublimating ices and nonvolatile crust are disjoint, the former deepening into crater-like hollows over many apparitions. The transition to nonvolatile crust is unstable, subject to competing consolidation and disruption processes, and sensitive to seasonal changes. While a low density snowball interior is favored, ice sheets or frozen lakes covering liquid or gas pockets might be formed and occasionally erupt. Comets vanish when crustal growth completely covers the surface, but are rejuvenated when a boulder impact starts a new crater. Nucleus splitting is seen as the culmination of irregular erosion, deepening the craters through a substantial fraction of the nucleus or through to a hollow center. ESA

N88-21954# Max-Planck-Inst. fuer Kernphysik, Heidelberg (West Germany).
SIMULATION OF COMETARY NUCLEI
E. Gruen, H. Kochan, K. Roessler, and D. Stoeffler (Muenster Univ., West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 501-508 (For primary document see N88-21884 14-91)
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Simulation experiments of cometary nuclei are planned in a satellite test facility (space simulator). This cylindrical chamber (3.5 m diameter and 4.8 m length) is equipped with a liquid nitrogen cooled inner surface and a solar radiation simulator up to 1.2 solar constants. Preparatory experiments are performed in small vacuum chambers. Sample production is by evaporation of a water-mineral suspension onto a cold plate or injection of the suspension into liquid nitrogen. Areas to be studied are: formation of regions with different activity such as crusts, release mechanisms of dust particles, and temperature profile and variations as a function of solar radiation intensity. The program is directed to test cometary models, to assist future cometary missions and to provide knowledge of sample handling at low temperatures. ESA

N88-21955# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Nuklearchemie.
DIVERSITY OF COMETS, SYNERGIC TEMPERATURE EFFECTS AND THE STABILITY OF ORGANIC COMPOUNDS IN ICY NUCLEI
K. Roessler and B. Nebeling *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 509-513 (For primary document see N88-21884 14-91)
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Comet evolution, particularly temperature effects, is discussed. The temperature of the surface of a young periodic comet rises from values much below 100 K to those beyond 200 K when reaching the inner solar system. The actual temperature depends on the orbit, in particular on the nearest distance to the Sun, and the age of the comet. Thermal effects such as phase transformations, the mobility of radiolytic radicals, destruction of clathrates or related water-volatile adducts, increase of gas pressure of volatiles, etc., may combine in a synergic way to explosive processes when crossing the temperature region between 100 and 170 K. This may explain the energetic dust jets observed on P/Halley. The radiation stability of organic compounds depends on the dose, the concentration of radicals formed, their mobility and reactivity. The synergic temperature effects may lead to an oxidation and destruction of organic monomeric compounds. Photolytic, radiolytic, and hot atom reactions of the solar radiation (photons and solar wind or flares) may induce the formation of thin crusts of organic polymers and refractories. ESA

N88-21956# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE COMET RENDEZVOUS ASTEROID FLYBY MISSION
M. Neugebauer *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 517-522 Original contains color illustrations (For primary document see N88-21884 14-91)
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The Comet Rendezvous Asteroid Flyby Mission (CRAF) is described. After gravity assists from Venus and Earth, the spacecraft will fly by the asteroid 46 Hestia en route to a rendezvous with P/Tempel 2 in Nov. 1996, when the comet is near aphelion. The scientific experiments for the CRAF mission are: an imaging system; a visual and infrared mapping spectrometer; an infrared radiometer; a penetrator carrying a gamma-ray spectrometer, a scanning differential calorimeter and evolved gas analyzer, accelerometers, and temperature probes; a neutral gas and thermal ion mass spectrometer; a secondary ion mass spectrometer for analyzing dust, gas, and thermal ions; a scanning electron microscope and particle analyzer; an X-ray fluorescence and gas chromatographic analyzer for collected dust and ice samples; a dust counter and velocity analyzer; a retarding potential ion mass spectrometer; a supra-thermal ion mass spectrometer and electron analyzer; a magnetometer; and a coordinated radio, electron, and plasma wave analyzer. ESA

N88-21957# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Space Science Dept.
THE GIOTTO EXTENDED MISSION
R. Reinhard *In its* Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 523-529 (For primary document see N88-21884 14-91)
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The status of Giotto is reviewed, and an extended mission is shown to be feasible. One week after the Halley flyby Giotto's orbit was changed so that it can return to the Earth. Using an Earth swingby on 2 July 1990, Giotto could be targeted to encounter a second comet. The short-period comet Grigg-Skjellerup was selected as the most suitable target. The encounter would occur on 10 July 1992, 12 days before its perihelion passage. Before the decision can be made to extend the Giotto mission the spacecraft and all experiments will be carefully checked out. This campaign is scheduled to take place at the end of 1989/early 1990, when Giotto, for the first time after the Halley encounter, is within 1 AU geocentric distance. ESA

N88-21958# Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass.
ROSETTA: A MISSION TO SAMPLE THE NUCLEUS OF A COMET
John A. Wood *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 531-537 (For primary document see N88-21884 14-91)
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The opportunities and problems of a spacecraft mission that would land on a comet nucleus, take samples, and return them in a suitably refrigerated state for study in terrestrial laboratories are discussed. These studies would greatly advance planetary science and astrophysics: the former by providing detailed information about pristine planetary material and planet-forming processes in the outer solar system; the latter by permitting the direct study of interstellar grains, individually and in great number. Laboratory techniques to handle and analyze fragile samples from the nucleus must be developed. Orbits of over 40 prospective target comets are listed. Spacecraft design and operation alternatives are summarized. ESA

N88-21959# Teledyne Brown Engineering, Huntsville, Ala.
RETRIEVING SAMPLES FROM COMET NUCLEI
Ernst Stuhlinger, Helmut Bassner, Hugo Fechtig, Eduard Igenbergs, Heribert Kuczera, Horst Loeb, and Detlef Schobert (Technische Univ., Munich, West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 539-546 (For primary document see N88-21884 14-91)
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A comet nucleus sampling scenario is proposed. Material samples for analysis in earth-based laboratories should be collected continuously to a depth of 3 m below the surface, and at a solar distance of at least 2.5 AU where the comet surface is inactive. The spacecraft is propelled by chemical and electric thrusters. While hovering above the comet nucleus at an altitude of 500 to 1000 m, the spacecraft will dispatch a rotating drill on a tether. The drill pipe will be driven into the nucleus by a rocket-powered reaction wheel. The inner pipe of the drill, when filled with cometary material, will be withdrawn by the tether, stored on the spacecraft, and transported back to Earth. ESA

N88-21960# Slovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Astronomy.
PLASMA TAIL OF COMET HALLEY IN JANUARY 1986
E. M. Pittich, J. Volankova, and D. Kubacek *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 549-553 (For primary document see N88-21884 14-91)
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A set of large-scale phenomena exposures of Comet Halley between January 5 and 10, 1986 is investigated. Within this period a disruption of the comet's plasma tail occurred. The elbow of the disrupted plasma tail observed on Jan. 10 moved from the nucleus at a mean radial velocity of 67 + or - 4 km/sec. The disruption started not more than 1 day before its detection on January 10. This disconnection event is studied in relation to the solar wind flow and the interplanetary magnetic field. It is impossible to say what caused the disruption. ESA

N88-21961# Universidad de la Laguna (Spain). Instituto de Astrofisica de Canarias.
THE EVOLUTION OF CN EMISSION IN HALLEY'S COMET WITH HELIOCENTRIC DISTANCE
M. Prieto, C. Garcia, F. Garzon, and M. Kidger (University Coll., London, England) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 561-565 (For primary document see N88-21884 14-91)
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The spectrum of Comet Halley was observed on various dates between Sept. 1985 and Dec. 1986, obtaining mulipositional long-slit absolute spectrophotometry of the inner region of the coma in the visible range, with a 2.5 m telescope. The emission in the 3883 A line of the (O-O) transition of CN was studied. Observed CN surface brightness spatial distribution is used to obtain the distribution of molecules and are fitted to Haser's model to obtain scale lengths. ESA

N88-21962# Physical Research Lab., Ahmedabad (India).
STUDY OF THE IONIC AND NEUTRAL SPECIES IN THE COMA OF COMET HALLEY WITH AN IMAGE INTENSIFIER CAMERA
T. Chandrasekhar, C. Debi Prasad, J. N. Desai, N. M. Ashok, and Ranjan Gupta *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 567-570 Sponsored by the Indian Government's Dept. of Space (For primary document see N88-21884 14-91)
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Imaging Fabry-Perot spectroscopy in the lines of hydrogen Balmer alpha and C2 and International Halley Watch (IHW) filter photography on Comet Halley carried out with a small telescope and an image intensifier camera are described. An event seen in H2O(+) emission and in the H alpha interferogram on Mar. 13, 1986 is detailed. ESA

N88-21963# Liege Univ. (Belgium). Inst. d'Astrophysique.
ON THE FORBIDDEN RED LINES OF OXYGEN IN COMETS
C. Arpigny, J. Manfroid, P. Magain, and R. Haefner (Technische Univ., Munich, West Germany) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 571-576 (For primary document see N88-21884 14-91)
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Eighteen spectra of 8 different comets observed at high and medium resolution were analyzed in the 627 to 637 nm region to determine the contributions of the (OI) red doublet and of the various NH2 lines present in this wavelength interval. Results confirm that there exist appreciable variations not only in the (OI)/NH2 ratio, but also in the relative intensities of the NH2 features among themselves, therefore, it is not justified to derive the (OI) line flux from the 630.0 blend, as was done in previous low-resolution work, by assuming a fixed relative strength of the NH2 emission contained in this blend. Mapping of these emissions over the coma is recommended. ESA

N88-21964# Bulgarian Academy of Sciences, Sofia. Dept. of Astronomy.
DETERMINATION OF THE CONTENT OF CO(+) AND H2O(+) IONS IN THE TAIL OF COMET GIACOBINI-ZINNER AND COMET HALLEY
V. Ivanova, K. Jockers (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany), and V. Shkodrov *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 577-581 Sponsored in part by the Max-Planck Society (For primary document see N88-21884 14-91)
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Objective prism spectra of Comets Giacobini-Zinner and Halley were obtained with a Schmidt telescope through a special double bandpass filter, which transmits the A sup 2 pi yields X sup 2 sigma(+) (2,0) band of CO(+) and the A bar sup 2 A sub 1 yields X bar sup 2 B sub 1 (0,7,0) band of H2O(+). Using extrafocal images of UBV standard stars taken immediately before or after the cometary exposures through the same filter, the plates were put on absolute scale and the CO(+) and H2O(+) content of the comet tail was derived. The values of the H2O(+) production, if compared with H2O production rates derived from IUE observations, seem high but still reasonable. The H2O/H2O(+) ratio varies by more than a decade. The H2O(+)/CO(+) ratio equals 2 in Giacobini-Zinner and 0.5 and 0.25 in Halley at 1.5 and 1 AU, respectively. The latter values are difficult to explain, since they are inconsistent with stationary ion flow or photochemical models. ESA

N88-21965# Nanjing Univ. (China). Dept. of Astronomy.
COMPARISON OF HALLEY'S MONOCHROMATIC COMAE WITH OTHERS
Zhong-wei Hu *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 583-589 (For primary document see N88-21884 14-91)
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Brightness profiles for Halley's CN, C2, C3 CO(+), and continuum comae are given. Scale lengths of CN, C2 and their parent molecules were derived by Haser's model. In order to study the dependences of the scale lengths on heliocentric distance, scale lengths of CN, C2 and their parent molecules for comets are plotted and compared. Production rates of CN, C2, C3, and OH for comets are plotted and compared, similarities and differences among comets are found from comparison. Observational techniques are reviewed. ESA

N88-21966# Bulgarian Academy of Sciences, Sofia. Dept. of Astronomy.
P/HALLEY ACTIVITY IN NOVEMBER 1985
T. Bonev, V. Shkodrov, V. Ivanova, and V. Boneva *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 591-594 (For primary

document see N88-21884 14-91)
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Photographs of P/Halley taken on a 50 to 70 cm Schmidt and a 2 cm RCC telescope are presented.The U- and B-plates of 12 and 13 Nov., 1985, show an ejection from the inner coma region towards the south. On 15 and 16 Nov., on U- and B-plates again, a strong ejection was recorded, extended to the north-northeast. At the same time in the R-band only a slight deformation of the coma can be seen. To explain these observations a model is proposed interpreting them as a high velocity ejection of matter off the rotating and precessing comet nucleus. Using this model, the orientation of the nucleus spin axis and the locations of the ejection sources are determined. ESA

N88-21967# Yunnan Univ., Kunming (China).
OUTBURST OF HALLEY'S COMET
P. S. Chen, Y. K. Chen, H. Gao, L. Li, Y. Zhang, J. Yang, and M. Mei (Beijing Normal Univ., China) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 595-597 (For primary document see N88-21884 14-91)
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During Mar. 20 to Apr. 3 of 1986, a photometric monitoring for the Halley's comet at optical and near infrared regions was made. It is shown that Halley's comet had a remarkable outburst after Mar. 20 but before Mar. 26 (perhaps on Mar. 22). During the outburst magnitudes in 3650A (cont), 4060A (C3), 4260A (CO+) and 4845A (cont) and J, H, K bands were much brighter than before and after. Characteristics of variations in all observed wavelengths and possible explanations for phenomena during the outburst are demonstrated. ESA

N88-21968# Vereinigung der Sternfreunde, Koenigswinter (West Germany). Comet Section.
COMET P/HALLEY: VISUAL MAGNITUDE ESTIMATES AND GAS PRODUCTION
D. Fischer and S. Huettemeister *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 599-605 (For primary document see N88-21884 14-91)
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Error sources in visual magnitude estimates of P/Halley were removed by a rigid selection procedure. From the remaining sample, brightness laws of two different types are deduced. Studies of molecular production rates and their changes during the 1985 to 1986 apparition of P/Halley are compared with these laws in order to obtain formulas transforming visual magnitude estimates directly into production rates, especially OH. Inconsistencies between different studies could not be reconciled, so only vague conclusions are possible. The dust content of a comet is cited as a potentially complicating factor in obtaining a simple law. ESA

N88-21969# Liege Univ. (Belgium). Inst. d'Astrophysique.
ON THE INTERPRETATION OF THE CH COMETARY SPECTRUM
C. Arpigny, C. J. Zeippen, M. Klutz, P. Magain (European Southern Observatory, Santiago, Chile), and D. Hutsemekers *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 607-612 (For primary document see N88-21884 14-91)
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A procedure to compute cometary spectra taking into account radiative processes and collisional effects is described. The populations of the rotational levels are determined by solving the statistical equilibrium equations at a certain number of locations within the coma (which can be modelled with n(R), T(R), v(R) laws) and the emerging intensity is then evaluated by integrating the emissions along the line of sight. Such a program was applied to the CH radical. The importance of collisions in exciting the lower rotational levels of CH is confirmed. ESA

N88-21970# Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie et Geophysique de l'Environment.
DIFFERENT TRAPPING MECHANISMS OF GASES BY WATER ICE AND THEIR RELEVANCE FOR COMET NUCLEI
B. Schmitt and J. Klinger *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 613-619 (For primary document see N88-21884 14-91)
(Grant ISU-57-24)
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The hypothesis that the large variability of the CO productions compared to the fairly constant CN/H2O, C2/CN and C3/CN ratios has its origin in the evolution processes of the nucleus was tested by simulating physical processes that may occur inside a comet nucleus. Results on the structure and dynamics of amorphous ice and on the formation and decomposition of clathrate hydrate are summarized. The physical evolutions that a comet nucleus could experience when subjected to a temperature gradient are outlined. From the analysis of this evolution scheme, conclusions on the chemical differentiation of the nucleus and on the production rates of the parent molecules released at the surface are presented. It is concluded that the large variability of CO and CO2 production rates between comets cannot be directly assigned to differences in initial composition. ESA

N88-21971*# Atmospheric and Environmental Research, Inc., Cambridge, Mass.
THE ROLE OF HYDROGEN THERMALIZATION IN SHAPING THE LYMAN-ALPHA COMA
Michael R. Combi and William H. Smyth (Conselho Nacional de Pesquisas, Rio de Janeiro, Brazil) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 621-626 (For primary document see N88-21884 14-91)
(Contracts NASw-3950; NASw-3966)
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Two interrelated aspects of the thermalization of cometary hydrogen were addressed using a three-dimensional Monte Carlo particle trajectory model: photochemical heating of the coma and the velocity distribution of cometary hydrogen leaving the inner coma that produces the extended Lyman-alpha coma. Observed cometary conditions were examined, ranging from productive comets like Kohoutek at very small heliocentric distances to intrinsically small comets like Giacobini-Zinner at 1 AU. The collisional decoupling of hydrogen yields bulk flow speeds and gas temperatures which are smaller than generally predicted in hydrodynamic models. By properly including these conditions the hydrogen velocity distribution required to produce the observed Lyman-alpha coma can be derived naturally. The two-dimensional morphology of the H coma is diagnostic of the physical conditions in the inner coma. ESA

N88-21972# Sao Paulo Univ. (Brazil). Inst. of Astronomy and Geophysics.
SPECTROPHOTOMETRIC OBSERVATIONS OF COMET HALLEY
J. A. deFreitasPacheco, S. J. C. Landaberry, and P. D. Singh *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 627-631 (For primary document see N88-21884 14-91)
(Contract CNPq-30.4076-77)
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Spectrophotometric observations of Comet Halley in the wavelength range 3600 to 7000 A during the period Oct. 5, 1985 and Apr. 9, 1986 were made. The observed fluxes of O(1D), CN388 nm) and C2(516 nm) are analyzed in the framework of Haser model. Production rates of these cometary species are determined. ESA

N88-21973# University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.
NATURE OF COMET HALLEY'S ORGANIC GRAINS INFERRED FROM INFRARED SPECTRA

M. K. Wallis, R. Rabilizirov, N. C. Wickramasinghe, and S. Al-Mufti *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 635-637 Sponsored by the United Kingdom Science and Engineering Research Council (For primary document see N88-21884 14-91)
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The infrared radiation from a distribution of organic grains in Halley's coma is compared with astronomical spectra, concentrating on the 3 to 4 micron region which discriminates between compositions. Grain temperatures appropriate to free space are calculated for nonevaporating and chemically charred material making up grains of various sizes. The particle size distribution found by the comet probes is used together with Mie theory to calculate the scattered light and thermal emission. Predictions for a biological composition are compared with the AAT spectrum of Comet Halley on 31 March, 1986. Day-to-day variability is modelled by changes in the size distribution, refractive index relative strength of the scattered component. It may alternatively be due partly to size-dependent chemical cooking and dynamics, superposed on variable output in comet jets. However, a second grain component, potentially biological, with a stronger 3.4 micron feature, is required to explain the 1 April, 1986, spectrum. The suggestion that grains comprised of biological organics can explain the 3.4 micron feature is thus confirmed. ESA

N88-21974# International School for Advanced Studies, Trieste (Italy).
THE DUST TAIL OF COMET HALLEY
M. Fulle, C. Barbieri, and G. Cremonese (Padua Univ., Italy) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 639-644 (For primary document see N88-21884 14-91)
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Photometric analysis of 10 wide field CCD images (702 nm and RG830 filters) of Halley between Feb. 24, and Apr. 5, 1986, is summarized. Derived isophote fields were used as input for the inverse approach to the Finson-Probstein method for interpreting cometary dust tails. This yields: dust ejection velocity of the dust from the inner coma; time-dependent dust size distribution; dust mass production rate; dust number production rate; and time-averaged dust size distribution. The error affecting the solutions = 50 percent. The results concern sizes between 0.7 and 300 microns ejected in the period between Jan. 15, and Mar. 15, 1986. The power index of the size distribution varies from -1 to -2 in January to -3 to -4 after the perihelion. On Mar. 13, 1986, (Giotto flight) small particles are predominant with a power index of -3.52, in agreement with the Giotto value of -3.48. The time-behavior of the dust production rate is very close to that of long-period Comet Bennett 1970II: the number rate increases by a factor 100,000, whereas the mass loss rate is constant. There is a weak indication of bursts possibly correlated with those claimed by Sekanina (1986). ESA

N88-21975# Comenius Univ., Bratislava (Czechoslovakia). Dept. of Astronomy.
THE STRUCTURE OF THE HALLEY METEOR STREAM AND THE ORBITAL HISTORY OF THE COMET
M. Hajdukova *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 645-647 (For primary document see N88-21884 14-91)
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Long base observations of the Orionid and Eta Aquarid meteor showers show structural features (secondary maxima, gradual shift of peak rates, etc.) which can be related to the orbital history of the parent comet. There are different possibilities to fit the observational data with theories of the motion of particles ejected from the comet. The long-term evolution of particle orbits leading to the formation of belts is compared with the relatively short-term diffusion process of ejected particles. The efficiency of both processes on the formation of the meteor stream is studied. The comparison of the theoretical limits for the spatial distribution of particles with the observational data confirms the long age of the stream and of the comet. ESA

N88-21976# Shanghai Observatory (China).
CLASSIFICATION OF COMETS RECORDED IN ANCIENT CHINA (300 BC - 1800 AD) AND STATISTICS OF TYPE-1 TAILS
Lin-shan Yan, Zhong-wei Hu (Nanjing Univ., China), and He-jun Quan *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 649-651 (For primary document see N88-21884 14-91)
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A total of 373 comets recorded in China from the 3rd century BC to the 18th century AD were examined. According to their morphology, color and length of tail, 92 Type-1 comets are found. The statistics show that: plasma tails of comets that reappeared within 2000 yr are very stable; the evolution of comets is in the stable stage. There is no correlation between the frequency of plasma tailed comets and solar activity. The relation between the events of comet and aurora are much closer than plasma tail of comet and aurora. ESA

N88-21977# Academy of Sciences (USSR), Dushanbe. Inst. of Astrophysics.
INTERACTION MECHANISMS OF COMETS WITH THE ZODIACAL DUST CLOUD
S. Ibadov *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 655-656 (For primary document see N88-21884 14-91)
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The interaction of the gas-dust cometary atmospheres with the dusty particles of zodiacal light is discussed. A meteor-like mechanism connected with cometary molecule - zodiacal dust grain impacts, and an explosion-type mechanism due to collisions of cometary and zodiacal dust particles are described. The meteor-like mechanism may produce mainly metallic atoms while the explosion-type mechanism may give multicharged ions of multielectron atoms, atoms of colliding grains, and X-ray radiation. For Halley type comets with the dust-to-gas production rate ratio greater than 0.1, the explosion-type mechanism is the main one. ESA

N88-21978# Tokyo Univ. (Japan). Dept. of Astronomy.
ON THE PERIODIC SOUTHWARD JETS OF COMET HALLEY BEFORE PERIHELION PASSAGE
Jun-ichi Watanabe, Hajime Kawakami, Koichiro Tomita, Kunio Takagishi, Hiroshi Kinoshita, Tsukou Nakamura, and Yoshihide Kozai (Tokyo Astronomical Observatory, Japan) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 657-663 (For primary document see N88-21884 14-91)
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Near nucleus CCD images of Comet Halley were taken from 10 Dec. of 1985 through 20 Jan. 1986, using 188 and 60 cm telescopes. The southward jet phenomenon is found to have 7 to 8 day period from the morphology. There are at least two sources of southward jets. The strength of the jet activity changed in each event, which implies that the rotational motion of the nucleus is not simple but complicated, including precessional motion. ESA

N88-21979# Remeis Sternwarte, Bamberg (West Germany).
DUST TAIL STREAMERS AND HALLEY'S NUCLEUS ROTATION
K. Beisser and H. Boehnhardt *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 665-670 (For primary document see N88-21884 14-91)
(Grant DFG-Ra-136/13-2)
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The Finson-Probstein approach to calculate the motion of dust particles in cometary tails was generalized and a computer code was developed to model the syndyne-synchrone pattern in the dust tails of comets. Appearance of the dust tail of Comet Halley during its 1986 return is outlined in a series of synchrone-syndyne plots. Using Schmidt telescope images of Halley a clear indication of the rotation period is found in the dust streamers (=synchrones) of the tail. ESA

N88-21980*# Arizona Univ., Tucson. Steward Observatory.
NEAR-INFRARED IMAGING OF COMET HALLEY: DISCOVERY OF A COLOR GRADIENT IN THE INNER COMA
M. J. Rieke and H. Campins (Planetary Science Inst., Tucson, Ariz.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 671-675 Sponsored by NASA and NSF (For primary document see N88-21884 14-91)
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Near-infrared images of Comet Halley were obtained in the standard J, H, and K bandpasses, on 3.5 Nov. 1985 with an HgCdTe camera at a 1.54 m telescope. Each image covers 38.4 arcsec on the side. A well defined gradient in the J-H and H-K colors within 5000 km of the nucleus is discovered with the bluest colors at the photocenter. Surface brightness profiles steeper than the canonical 1/rho are observed in the same region. Analysis indicates that the color gradient and the brightness profiles can both be explained by the presence of volatile (dirty ice) grains in the inner coma. An outburst of very small (Rayleigh scattering) dust particles could also account for the observations, however, this model is not supported by the spacecraft measurements. No obvious jets or other structures are observed. ESA

N88-21981# Lecce Univ. (Italy). Dept. of Physics.
LABORATORY AMORPHOUS CARBON: A POSSIBLE ANALOG OF COMETARY DUST
A. Blanco, A. Borghesi, S. Fonti, V. Orofino, E. Bussoletti, and L. Colangeli (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 677-679 (For primary document see N88-21884 14-91)
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The possibility that the Halley 3.4 micron emission band is due to hydrogenated amporphous carbon grains of 80A diameter was studied in the laboratory. If the hypothesis is true, the grains would be 0.1 to 0.2 percent of the total mass rate and 1 to 10 percent of the mass rate for particles with masses smaller than 0.00001 g. ESA

N88-21982# Academy of Sciences (USSR), Leningrad. Main Astronomical Observatory.
LINEAR AND CIRCULAR POLARIZATION OF COMET HALLEY LIGHT
N. G. Beskrovnaja, N. A. Silantev, N. N. Kiselev, and G. P. Chernova (Academy of Sciences, USSR, Dushanbe) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 681-685 (For primary document see N88-21884 14-91)
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Polarimetry of Comet Halley reveals gradual turning of the polarization plane relative to the scattering plane in the inversion angle vicinity, and circular polarization. The polarization plane turning has no explanation in terms of Mie scattering theory. The phase dependence of integrated polarization and both findings are results of solar light scattering by fine oriented (aligned) particles. ESA

N88-21983# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IMAGE PROCESSING ON VEGA PICTURES c35
A. Abergel, J. L. Bertaux, and E. Dimarellis *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 689-694 Original contains color illustrations (For primary document see N88-21884 14-91)
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Noise reduction in raw TV images of Comet Halley received from VEGA 1 and 2 is described. The periodic components of the noise are first eliminated by two dimensional Fourier filtering. Then the contrast of the filtered images is locally enhanced to detect with no ambiguity the limb of the sunlit nucleus and structures in the coma images obtained far from the nucleus. ESA

N88-21984# Observatoire de Besancon (France).
THE LIGHT CURVE OF P/HALLEY AND THE ROTATION OF ITS NUCLEUS c74
M. C. Festou, P. Drossart, J. Lecacheux, T. Encrenaz, F. Puel, and J. L. Kohl-Moreira (Observatoire de Paris-Meudon, France) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 695-701 (For primary document see N88-21884 14-91)
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Photometric measurements of Comet Halley exhibit a photometric periodicity of 7.307 + or - 0.005 days. Brightness variations occur together with the periodic release of solid particles during bursts of activity or activity increases of the nucleus. The mechanical behavior of the comet nucleus can be described as that of an axisymmetric ellipsoid. The permanence of the periodicity during at least half the apparition of the comet indicates that no internal damping of the rotation exists and that the nucleus must then be rigid. Since this precession axis lies close to the perpendicular to the orbital plane, then the photometric behavior of the comet and that of the nucleus gaseous output during the entire apparition can be explained if most of the activity takes place in one main active (or a group of) spot(s) located not too close from the poles of the nucleus. In the torque free approximation, it is found that the nucleus rotates about its long axis in 14.614 days. A free precession about an axis tilted by 84 deg to the rotation axis occurs in 2.088 days. Due to this peculiar geometry, the true photometric period is 14.6 days, with two halves nearly identical, thus mimicking a periodicity of 7.3 days. The mean albedo of the areas of the dark areas of the nucleus is 3 percent. The icy patches have an albedo of 8 to 12 percent and are very dusty. ESA

N88-21985# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Lab. de Physique Stellaire et Planetaire.
TEMPERATURE OF THE NUCLEUS OF COMET HALLEY
C. Emerich, J. M. Lamarre, R. Gispert, N. Coron, M. Combes, T. Encrenaz, J. Crovisier, E. Rocard, J. P. Bibring, and V. I. Moroz (Academy of Sciences, USSR, Moscow) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 703-706 (For primary document see N88-21884 14-91)
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The infrared thermal radiation of the nucleus of Halley's comet at 0.8 AU from the Sun was measured by the imaging channel of the IKS-VEGA-1 spectrophotometer in wavelengths bands 7 to 10 and 9 to 14 micron. Near the closest approach, the color temperature of the nucleus is between 370 and 450 K. A maximum brightness surface temperature between 350 and 400 K is deduced around the subsolar direction, from the value of the measured fluxes. The surface temperature of the nucleus is shown to be subject to high gradients relative to the Sun direction. These observations suggest that a large part of Halley's nucleus is covered by a refractory, dark, and inactive crust. ESA

N88-21986# Slovak Academy of Sciences, Skalnate Pleso (Czechoslovakia). Inst. of Astronomy.
CONSEQUENCES OF THE SIZE DETERMINATION OF P/HALLEY BY SPACE PROBES ON THE SCALE OF SIZES OF COMETARY NUCLEI
J. Svoren *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 707-712 (For primary document see N88-21884 14-91)
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Photometric data referring to heliocentric distances beyond 2.5 AU on the preperihelion arc of the orbit of P/Halley are used to determine comet size. Only 2 straight lines are sufficient for a description of the behavior of the comet, n = 0.7 for 11 to 7.6 AU and n = 5.8 for 7.6 to 2.5 AU. At the time of the discovery P/Halley was brighter than predicted by the standard law and the discovery of P/Halley on Oct. 1982 was made possible by its brightening. On the basis of the estimate of a projected area of 100 sq km, and of brightness 24.1m at the extreme distance,

albedo = 0.055 has been derived. This value of albedo is used to calculate the radii of short-period comets. One possibility to explain the small difference between sizes of long-period and short-period comets, is that the mass loss causes the decrease of density of a nucleus. ESA

N88-21987# Academy of Sciences (USSR), Dushanbe. Inst. of Astrophysics.
PHYSICAL-MECHANICAL PROPERTIES OF MATRICES ON THE COMET NUCLEI SURFACE MODELS
Kh. I. Ibadinov, S. A. Aliev, and A. A. Rahmonov *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 713-716 (For primary document see N88-21884 14-91)
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By the method of laboratory modeling, physical-mechanical properties of dust matrices (from SiO2, C) and organic matrices (from DL-alanine, DL-treonine, L-valine) were studied. In most cases the matrices are very porous (0.6 to 0.9), have low density (10 to 50 kg/cu m) and mechanical strength 5000 to 50,000 Pa. Under experimental conditions similar to the position of a comet nucleus at 1 AU from the Sun, matrices some millimeters thick are produced at a rate of 8 times 10 to the minus 8th power/m/sec on the surface of H2O ice. ESA

N88-21988# Academy of Sciences (USSR), Dushanbe. Inst. of Astrophysics.
SUBLIMATION CHARACTERISTICS OF H2O COMET NUCLEUS WITH CO2 IMPURITIES
Kh. I. Ibadinov and S. A. Aliev *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 717-719 (For primary document see N88-21884 14-91)
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By the method of laboratory modeling the sublimation of an H2O ice comet nucleus model containing up to 4.4 percent CO2 was studied. It is found that the destruction of the model surface takes place in the form of microexplosions with ejection of ice particles up to 1.2 mm in size. It is concluded that in comet nuclear surface layer conditions, the CO2 concentration in H2O ices could not be more than a few per cents. ESA

N88-21989# Academia Sinica, Nanjing (China). Purple Mountain Observatory.
THE SPLITTING OF COMET HALLEY 1986
Dao-han Chen, Jia-quing Zheng, Zong-li Liu, Lin-shan Yan, Lin-zhong Lui, Xing-hai Zhou, Zhi-xian Wu, and A. C. Gilmore (Mount John Univ. Observatory, Lake Tepako, New Zealand) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 721-724 (For primary document see N88-21884 14-91)
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Nine photographs taken on 25 Mar., 1986 show that the nucleus of Comet Halley split into 2 widely separated nuclei. The separated projected distance on the plane of the sky is 5000 km. The principal nucleus and the secondary nucleus exhibit their own comas. The prominant jet ejected from the companion curves up to a height of several thousand kilometers and the secondary nucleus must fade out of sight within only a few days. In combination with the results of photoelectric observations it seems that this event of splitting coincides with an outburst. Photographs were digitized, and the image enhancement is described. ESA

N88-21990*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ALTERNATIVE COMETARY TARGETS FOR THE GIOTTO EXTENDED MISSION
R. W. Farquhar, D. W. Dunham, and S. C. Hsu (Computer Sciences Corp., Silver Spring, Md.) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 727-731 (For primary document see N88-21884 14-91)
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The plan to use an Earth gravity-assist maneuver to redirect the Giotto spacecraft toward Comet Grigg-Skjellerup (GS) for an encounter in July 1992, and 2 additional cometary opportunities are discussed. The first is an encounter with Comet Hartley-2 (H2) in Aug., 1991. The H2 is intrinsically brighter than GS and the encounter would take place much closer to the Earth. The other potential target is Comet du Toit-Hartley (DTH), which is of considerable scientific interest because it split into 2 pieces during its 1979 apparition. Ths GS and H2 missions are the most viable; DTH is eliminated because its aphelion of transfer orbit and Sun distance at encounter (both 1.2 AU) are incompatible with Giotto's degraded thermal insulation. ESA

N88-21991# Slovak Academy of Sciences, Skalnate Pleso (Czechoslovakia). Inst. of Astronomy.
THE MASS LOSS RATES OF PERIODIC COMETS
L. Kresak and M. Kresakova *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 739-744 (For primary document see N88-21884 14-91)
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The mass loss rates integrated over the last 2 centuries are determined for all the known periodic comets of q less than 3 AU, on the basis of their absolute total brightness and orbital evolution. They cover a range from 100 million to 1 trillon kg/century and undergo appreciable temporal variations. The average total mass loss is estimated at 3 trillion kg/century (equivalent to 1 object of absolute total magnitude 6.3 staying all the time at r = 1 AU). Nearly one half of this is contributed by P/Halley and P/Encke alone. While the amount of gas seems to be fairly well determined, only the dust particles escaping with it are included. Their input is too small to maintain the interplanetary dust complex in equilibrium, and it is suggested that most of the dust supply is due to inactive objects: larger fragments of cometary nuclei, their extinct cores, and asteroids. ESA

N88-21992# Polish Academy of Sciences, Warsaw. Space Research Center.
THREE APPROACHES TO THE MODELING OF COMET HALLEY'S MOTION OVER LONG PERIODS OF TIME
K. Ziolkowski *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 747-750 (For primary document see N88-21884 14-91)
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Three stages in the investigation of the long-term motion of Comet Halley: semianalytical methods for prediction of the past perihelion passages; numerical integrations of the comet's equations of motion based on the orbital elements linked to the last few apparitions of the comet; and an approach enabling the use of the full observational material since 240 BC to determine the starting parameters for numerical integration are reviewed. A comparison of the results obtained by the methods is used to formulate conclusions concerning reliability of the models as well as the necessity for further research. ESA

N88-21993# Polish Academy of Sciences, Warsaw. Space Research Center.
A MODEL OF THE NONGRAVITATIONAL MOTION OF COMET P/ENCKE
G. Sitarski *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 751-752 (For primary document see N88-21884 14-91)
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Motion of P/Encke over the last two centuries was investigated assuming the nongravitational effects as a daily change of the semimajor axis of the comet's orbit. It is found that a variability of the nongravitational effects can be approximated by a sinusoidal function of time, the parameters of which were determined from observational equations along with corrections to the orbital elements. This model of the comet's motion allows the observed perihelion times to be represented to within 0.025 of a day. ESA

N88-21994# Tuebingen Univ. (West Germany). Inst. fuer Astronomie.
THE OBSERVABILITY OF CARBON MONOXIDE IN PLANETARY NEBULAE Thesis [ZUR BEOBACHTBARKEIT VON KOHLENMONOXID IN PLANETARISCHEN NEBELN]
Hans-Christoph Kreysing Aug. 1987 100 p In GERMAN
(ETN-88-91498) Avail: NTIS HC A05/MF A01

Measurements on the planetary nebula NGC 7027 were reevaluated, and the observability of CO was investigated. The evolution from red giant to white dwarf star is outlined. Previous molecular investigations in circumstellar envelopes are summarized, with emphasis on the results obtained for NGC 7027. The CO-density, synthesis reactions and decay reactions, as well as the decay of CO by photodissociation are reviewed. Density profiles of CO were calculated using the program MODEL 1; the envelope masses were calculated using the program MODEL 2. ESA

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N88-21995*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. Ist. di Fisica dello Spazio Interplanetario.
MAGNETIC FIELD HOURLY AVERAGES FROM THE ROME-GSFC EXPERIMENT ABOARD HELIOS 1 AND HELIOS 2
F. Mariani, N. F. Ness, B. Bavassano, R. Bruno, R. Buccellato, L. F. Burlaga, S. Cantarano, C. S. Scearce, R. Terenzi, and U. Villante (Aquila Univ., Italy) Jan. 1987 139 p
(NASA-TM-89782; NAS 1.15:89782; IFSI-87-1; ETN-88-91288)
Avail: NTIS HC A07/MF A01 CSCL 03B

Plots of all the hourly averages computed from the solar magnetic field measurements obtained during the mission are given separately for Helios 1 and Helios 2. The magnitude and the direction of the averaged field are plotted versus the number of solar rotations as seen from Helios, counted from launch. ESA

N88-21996 Technische Univ., Hanover (West Germany). Astronomisches Station.
SUNSPOT FREQUENCY AND SOLAR ACTIVITY [SONNENFLECKENHAEUFIGKEIT UND SONNENAKTIVITAET]
Karl Pilowski 1987 36 p In GERMAN; ENGLISH summary
(Publ-17/87; ETN-88-91504) Avail: Universitaet Hannover, Welfengarten 1, D-3000 Hannover 1, Fed. Republic of Germany

The basic and far-reaching changes which occurred in the treatment and the understanding of sunspot frequency and solar activity during the last 20 years are described. Precise and extended definitions of the relevant notions in this research field are given, with emphasis on the notion of planetary control of solar activity and on the mathematically periodic distributions of the sunspot relative numbers. ESA

N88-21997# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 519, NOVEMBER 1987. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MAY 1987 AND MISCELLANEA
Helen E. Coffey, ed. and John A. McKinnon, ed. Nov. 1987 66 p
(Contract N00014-86-F-0049)
(PB88-158910; SGD-519-PT-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A04/MF A01 CSCL 03B

Contained are the detailed index for 1987 and the data for May 1987 (Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar X-ray radiation from GOES satellite, mass ejections for the sun, and active prominences and filaments). GRA

N88-21998# National Center for Atmospheric Research, Boulder, Colo.
TABLE OF SOLAR ACTIVITY ASSOCIATED WITH CORONAL MASS EJECTIONS OBSERVED BY THE SMM CORONAGRAPH/POLARIMETER IN 1980
D. F. Webb Oct. 1987 41 p Prepared in cooperation with Emmanuel Coll., Boston, Mass.
(Grant NSF ATM-87-09659)
(PB88-170881; NCAR/TN-297-STR) Avail: NTIS HC A03/MF A01 CSCL 03B

This report is the description and presentation of a table of solar activity considered to be associated with coronal mass ejections (CMEs) as observed during 1980 with the High Altitude Observatory's Coronograph/Polarimeter (C/P) an the SMM spacecraft. The list has formed the basic data set for serveral studies, most prominently, a study of CME associations publisher by Webb and Hundhausen (1987). An attendant source of CME data is the unpublished C/P Event List for 1980, which co-evolved with the association list under the guidance of Art Hundhausen. Discussions of the details of the selection and verification of the list of SMM CMEs are in the above paper as well as in the papers of Hundhausen et al (1984) and Hundhausen (1987). GRA

N88-21890# Tokyo Univ. (Japan). Inst. of Space and Astronomical Science.
SOLAR WIND OBSERVATION AT THE TIME OF CLOSEST ENCOUNTER WITH COMET HALLEY
K. I. Oyama and T. Abe (University of Electro-Communications, Tokyo, Japan) *In* ESA, Proceedings of the International Symposium on the Diversity and Similarity of Comets Sep. 1987 p 57-6 (For primary document see N88-21884 14-91)
Copyright Avail: NTIS HC A99/MF E03

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N88-21999# Rome Univ. (Italy). Dipt. di Fisica.
HIGH ENERGY COSMIC MUONS AND THE CALIBRATION OF THE L3 ELECTROMAGNETIC CALORIMETER
M. Micke (Technische Hochschule, Aachen, West Germany), S. Morganti, and S. Salsedo 30 Sep. 1987 29 p
(Nota-Interna-895; ETN-88-92251) Avail: NTIS HC A03/MF A01

An experiment was performed with a 10 x 10 BGO crystal matrix to define a calibration procedure with high energy cosmic muons to be applied to the calorimeter before the installation and inside the L3 electromagnetic calorimeter pit. Calibration constants were evaluated at the 2 percnet level collecting 200 muons per crystal in 10 days of data taking; an algorithm to minimize the uncertainty on the track length determination was developed, proving the feasibility of the cosmic muon calibration of the calorimeter. Muons can easily provide a set of intercalibration constants in the test period and during operation. The comparison between them will account for changes in the response of individual crystal. The absolute scale for the muon calibration constants when the calorimeter is in situ within the L3 experiment can be fixed in two ways: by physical processes in at least a fraction of the detector; and by measuring the cosmic muon momemtum by the muon spectrometer and using the dE/dx information. Since the measurement proves that the track length inside the crystal can be determined with the necessary accuracy, it is concluded that this method can be used to measure the light response of each crystal and its variation along the major axis. ESA

99 GENERAL

N88-22000# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).
[ACTIVITIES REPORT IN FLIGHT AND SPACE TRAVEL] Annual Report, 1986
Aug. 1987 126 p In GERMAN; ENGLISH summary Original document contains color illustrations
(ISSN-0070-3966; ETN-88-92102) Avail: NTIS HC A07/MF A01;

Research concerning air traffic management (DIVA Flight Test Analysis for ATTAS); boundary layer transition investigations with the LFU-205 aircraft; fire safety of aircraft cabins; thermal propulsion systems and high energy lasers; nonnuclear energy systems (wind energy converter); satellite communication and localization (satellite experiments for aeronautical communication); remote sensing of forest damage; a facility to simulate operations in the proximity of spacecraft; and a ringless ceramic Diesel engine is summarized. ESA

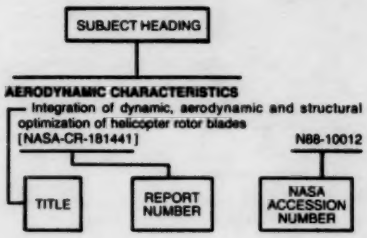
N88-22001# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
AGARD HIGHLIGHTS 88/1
[1988] 45 p
Copyright Avail: NTIS HC A03/MF A01

Topics addressed include: cooperative research and development in NATO; electromagnetic wave propagation; and systems integration and emerging technologies in the development of weapons systems. B.G.

N88-22002*# New World Services, Inc., Fla.
CHRONOLOGY OF KSC AND KSC RELATED EVENTS FOR 1987 Annual Report, 1987
Ken Nail, Jr., comp. and Elaine Liston, comp. Mar. 1988 112 p
(Contract NAS10-600)
(NASA-CR-182754; NAS 1.26:182754; KHR-12) Avail: NTIS HC A06/MF A01 CSCL 05D

This document presents the historical record of the Kennedy Space Center's place in the overall NASA progress. It also serves as a source for historians and other researchers. Arrangement is by day and month and individual articles are attributed to published sources. An index is added to this edition. Author

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7053).

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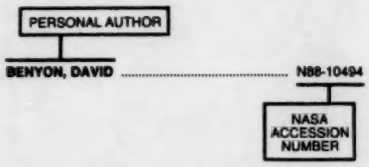

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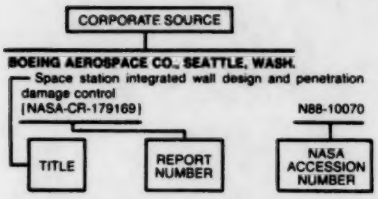

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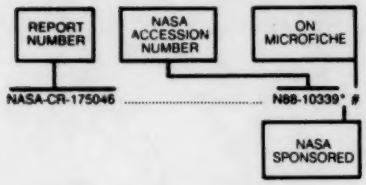

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(517) 373-1593

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7870

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

UNIVERSITY OF NEBRASKA - LINCOLN
Love Library
Documents Department
Lincoln, NE 68588-0410
(402) 472-2562

NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557-0044
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101-0630
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3826

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Davis Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1151

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-4629
In cooperation with North Dakota State Univ. Library

OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43266-0334
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78711
(512) 475-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22903-2498
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506-6069
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
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Milwaukee, WI 53233
(414) 278-3065

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

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WYOMING STATE LIBRARY
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